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Subject: Project Approval Signatures:
FY14 CoF Hangar Fire Protection – Base Bid

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PROJECT TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 15 LIST OF DRAWINGS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00 SUMMARY OF WORK
01 14 00 WORK RESTRICTIONS
01 20 00.00 20 PRICE AND PAYMENT PROCEDURES
01 30 00 ADMINISTRATIVE REQUIREMENTS
01 32 01.00 10 PROJECT SCHEDULE
01 33 00 SUBMITTAL PROCEDURES
01 35 14.11 40 AFRC SAFETY REQUIREMENTS
01 35 40.00 20 ENVIRONMENTAL MANAGEMENT
01 42 00 SOURCES FOR REFERENCE PUBLICATIONS
01 45 00.10 40 CONTRACTOR QUALITY CONTROL
01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS
01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
01 62 35 RECYCLED / RECOVERED MATERIALS
01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01 75 00.00 40 AFRC STARTUP AND COMMISSIONING
01 78 00 CLOSEOUT SUBMITTALS
01 78 23 OPERATION AND MAINTENANCE DATA
01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS
01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS

DIVISION 02 - EXISTING CONDITIONS

02 41 00 DEMOLITION AND DECONSTRUCTION
02 83 13.00 20 LEAD IN CONSTRUCTION

DIVISION 03 - CONCRETE

03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE

DIVISION 05 - METALS

05 50 13 MISCELLANEOUS METAL FABRICATIONS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00 ROUGH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 54 19 POLYVINYL-CHLORIDE AND THERMOPLASTIC POLYOLEFIN ROOFING
07 60 00 FLASHING AND SHEET METAL
07 61 14.00 20 STEEL STANDING SEAM ROOFING
07 84 00 FIRESTOPPING
07 92 00 JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13 STEEL DOORS AND FRAMES
08 71 00 DOOR HARDWARE

DIVISION 09 - FINISHES

09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD
09 29 00 GYPSUM BOARD
09 51 00 ACOUSTICAL CEILINGS
09 90 00 PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10 44 00 FIRE PROTECTION SPECIALTY

DIVISION 21 - FIRE SUPPRESSION

21 13 00.00 40 FIRE-SUPPRESSION SPRINKLER SYSTEMS
21 13 18.00 10 PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION
21 13 20.00 20 FOAM FIRE EXTINGUISHING FOR AIRCRAFT HANGARS
21 13 24.00 10 AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM
21 30 00 FIRE PUMPS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS
23 31 13.00 40 METAL DUCTS
23 37 13.00 40 DIFFUSERS, REGISTERS, AND GRILLS

DIVISION 26 - ELECTRICAL

26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS
26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL
26 05 13.00 40 MEDIUM-VOLTAGE CABLES
26 05 19.00 10 INSULATED WIRE AND CABLE
26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES
26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES
26 08 00 APPARATUS INSPECTION AND TESTING
26 12 19.00 40 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
26 20 00 INTERIOR DISTRIBUTION SYSTEM
26 28 21.00 40 AUTOMATIC TRANSFER SWITCHES

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

DIVISION 31 - EARTHWORK

31 00 00 EARTHWORK
31 11 00 CLEARING AND GRUBBING
31 32 11 SOIL SURFACE EROSION CONTROL

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 31 13 CHAIN LINK FENCES AND GATES

DIVISION 33 - UTILITIES

33 40 00 STORM DRAINAGE UTILITIES
33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

-- End of Project Table of Contents --

SECTION 00 01 15

LIST OF DRAWINGS
02/11

PART 1 GENERAL

1.1 SUMMARY

This section lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings, Maps and Specifications."

1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

DRAWING NO.	REVISION NO.	TITLE
G000		TITLE SHEET
G001		GENERAL INFORMATION
G002		CODE INFORMATION AND DRAWING INDEX
A-201		BUILDING 4801 REFLECTED CEILING PLAN
A-202		BUILDING 4802 REFLECTED CEILING PLAN
A-203		BUILDING 4840 REFLECTED CEILING PLAN
A-501		BUILDING 4840 BUILDING SECTION
A-801		DETAILS
A-802		DETAILS
C-1		WATER CONNECTION PLAN
C-1		TRANSFORMER PLAN
S001		STRUCTURAL INFORMATION
S601		STRUCTURAL SECTIONS AND DETAILS
S602		STRUCTURAL SECTIONS AND DETAILS
E000		ELECTRICAL GENERAL NOTES AND LEGEND
E001		OVERALL ELECTRICAL SITE PLAN
E002		ELECTRICAL DUCT BANK PLAN
ED100		ELECTRICAL DEMOLITION PLAN- BLDG 4853
ED101		ELECTRICAL DEMOLITION PLAN- BLDG 4801
ED102		ELECTRICAL DEMOLITION PLAN- BLDG 4802
ED103		ELECTRICAL DEMOLITION PLAN- BLDG 4840
E100		ELECTRICAL PLAN AND NOTES - BLDG 4853
E101		ELECTRICAL PLAN AND NOTES - BLDG 4801
E102		ELECTRICAL PLAN AND NOTES - BLDG 4802
E103		ELECTRICAL PLAN AND NOTES - BLDG 4840
E200A		ONE LINE DIAGRAM - PEDC BLDG - SUB STATION #16
E200		PARTIAL ONE LINE DIAGRAM & SCHEDULES - BLDG 4853
E201		PARTIAL ONE LINE DIAGRAM & SCHEDULES - BLDG 4801
E202		PARTIAL ONE LINE DIAGRAM & SCHEDULES - BLDG 4802
E203		PARTIAL ONE LINE DIAGRAM & SCHEDULES - BLDG 4840
F000		FIRE PROTECTION OVERALL SITE PLAN AND LEGEND
F001		FIRE PROTECTION ENLARGED SITE PLAN

DRAWING NO.	REVISION NO.	TITLE
F002		FIRE PROTECTION ENLARGED SITE PLAN
F100		FIRE SPRINKLER OVERALL DEMOLITION PLAN - BLDG 4853
F101		FIRE SPRINKLER OVERALL DEMOLITION PLAN - BLDG 4801
F101A		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4801 AREA A
F101B		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4801 AREA B
F102		FIRE SPRINKLER OVERALL DEMOLITION PLAN - BLDG 4802
F102A		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4802 AREA A
F102B		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4802 AREA B
F102C		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4802 AREA C
F103		FIRE SPRINKLER OVERALL DEMOLITION PLAN - BLDG 4840
F103A		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA A
F103B		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA B
F103C		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA C
F103D		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA D
F103E		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 PUMP ROOM
F111		FOAM SUPPRESSION OVERALL DEMOLITION PLAN - BLDG 4801
F111A		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4801 AREA A
F111B		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4801 AREA B
F111C		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4801 PUMP ROOM
F112		FOAM SUPPRESSION OVERALL DEMOLITION PLAN - BLDG 4802
F112A		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4802 AREA A
F112B		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4802 AREA B
F112C		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4802 AREA C
F112D		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4802 PUMP ROOM
F113		FOAM SUPPRESSION OVERALL DEMOLITION PLAN - BLDG 4840
F113A		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4840 AREA A
F113B		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4840 AREA B
F113C		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4840 AREA C
F113D		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4840 AREA D
F113E		FOAM SUPPRESSION ENLARGED DEMOLITION PLAN - BLDG 4840 PUMP ROOM
F120		FIRE ALARM DEMOLITION PLAN - BLDG 4853
F121		FIRE ALARM OVERALL DEMOLITION PLAN - BLDG 4801
F121A		FIRE ALARM ENLARGED DEMOLITION PLAN - BLDG 4801 AREA A
F121B		FIRE ALARM ENLARGED DEMOLITION PLAN - 4801 AREA B
F122		FIRE ALARM OVERALL DEMOLITION PLAN - BLDG 4802
F122A		FIRE ALARM ENLARGED DEMOLITION PLAN - BLDG 4802 AREA A
F122B		FIRE ALARM ENLARGED DEMOLITION PLAN - BLDG 4802 AREA B
F122C		FIRE ALARM ENLARGED DEMOLITION PLAN - BLDG 4802 AREA C
F123		FIRE ALARM OVERALL DEMOLITION PLAN - BLDG 4840
F123A		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA A
F123B		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA B
F123C		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA C
F123D		FIRE SPRINKLER ENLARGED DEMOLITION PLAN - BLDG 4840 AREA D
F200		FIRE SPRINKLER OVERALL PLAN - BLDG 4853
F201		FIRE SPRINKLER OVERALL PLAN - BLDG 4801
F201A		FIRE SPRINKLER ENLARGED PLAN - BLDG 4801 AREA A
F201B		FIRE SPRINKLER ENLARGED PLAN - BLDG 4801 AREA B
F202		FIRE SPRINKLER OVERALL PLAN - BLDG 4802
F202A		FIRE SPRINKLER ENLARGED PLAN - BLDG 4802 AREA A
F202B		FIRE SPRINKLER ENLARGED PLAN - BLDG 4802 AREA B
F202C		FIRE SPRINKLER ENLARGED PLAN - BLDG 4802 AREA C
F203		FIRE SPRINKLER OVERALL PLAN - BLDG 4840
F203A		FIRE SPRINKLER ENLARGED PLAN - BLDG 4840 AREA A

DRAWING NO.	REVISION NO.	TITLE
F203B		FIRE SPRINKLER ENLARGED PLAN - BLDG 4840 AREA B
F203C		FIRE SPRINKLER ENLARGED PLAN - BLDG 4840 AREA C
F203D		FIRE SPRINKLER ENLARGED PLAN - BLDG 4840 AREA D
F203E		FIRE SPRINKLER ENLARGED PLAN - BLDG 4840 PUMP ROOM
F211		FOAM SUPPRESSION OVERALL PLAN - BLDG 4801
F211A		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4801 AREA A
F211B		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4801 AREA B
F211C		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4801 PUMP ROOM
F212		FOAM SUPPRESSION OVERALL PLAN - BLDG 4802
F212A		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4802 AREA A
F212B		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4802 AREA B
F212C		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4802 AREA C
F212D		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4802 PUMP ROOM
F213		FOAM SUPPRESSION OVERALL PLAN - BLDG 4840
F213A		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4840 AREA A
F213B		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4840 AREA B
F213C		FOAM SUPPRESSION ENLARGED PLAN - BLDG 4840 AREA C
F213D		FOAM SUPRESSION ENLARGED PLAN - BLDG 4840 AREA D
F213E		FOAM SUPRESSION ENLARGED PLAN - BLDG 4840 PUMP ROOM
F220		FIRE ALARM PLAN- BLDG 4853
F221		FIRE ALARM OVERALL PLAN - BLDG 4801
F221A		FIRE ALARM ENLARGED PLAN - BLDG 4801 AREA A
F221B		FIRE ALARM ENLARGED PLAN - NLDG 4801 AREA B
F222		FIRE ALARM OVERALL PLAN - BLDG 4802
F222A		FIRE ALARM ENLARGED PLAN - BLDG 4802 AREA A
F222B		FIRE ALARM ENLARGED PLAN - BLDG 4802 AREA B
F222C		FIRE ALARM ENLARGED PLAN - BLDG 4802 AREA C
F223		FIRRE ALARM OVERALL PLAN - BLDG 4840
F223A		FIRE ALARM ENLARGED PLAN - BLDG 4840 AREA A
F223B		FIRE ALARM ENLARGED PLAN - BLDG 4840 AREA B
F223C		FIRE ALARM ENLARGED PLAN - BLDG 4840 AREA C
F223D		FIRE ALARM ENLARGED PLAN - BLDG 4840 AREA D
F301		DEMOLITION RISER PLAN - BLDG 4801
F302A		DEMOLITION RISER PLAN - BLDG 4802 ZONE 1 AND ZONE 2
F302B		DEMOLITION RISER PLAN - BLDG 4802 ZONE 3 AND ZONE 4
F302C		DEMOLOTION RISER PLAN - BLDG 4802 ZONE 5 AND ZONE 6
F302D		DEMOLITION RISER PLAN - BLDG 4802 ZONE 7 AND ZONE 8
F302E		DEMOLITION RISER PLAN - BLDG 4802 ZONE 9 AND ZONE 10
F303		DEMOLITION RISER PLAN - BUILDING 4840
F351		RISER PLAN - BLDG 4801
F352A		RISER PLAN - BLDG 4802 ZONE 1 AND ZONE 2
F352B		RISER PLAN - BLDG 4802 ZONE 3 AND ZONE 4
F352C		RISER PLAN - BLDG 4802 ZONE 5 AND ZONE 6
F352D		RISER PLAN - BLDG 4802 ZONE 7 AND ZONE 8
F352E		RISER PLAN - BLDG 4802 ZONE 9 AND ZONE 10
F353		RISER PLAN - BLDG 4840
F400		ADDITIONAL DETAILS
F401		ADDITIONAL DETAILS
M000		MECHANICAL LEGEND, GENERAL NOTES AND DETAILS
M-100		MECHANICAL PLAN - BUILDING 4801

DRAWING NO.	REVISION NO.	TITLE
M-101-		MECHANICAL PLAN - BUILDING 4802
M-102-		MECHANICAL PLAN - BUILDING 4840

-- End of Document --

SECTION 01 11 00

SUMMARY OF WORK
01/08

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the labor, equipment, and materials to perform Repair Aircraft Hangar Fire Protection Systems for the National Aeronautics and Space Administration at the main campus Armstrong Flight Research Center (NASA/AFRC), Edwards, California 93523.

a. The site work scope includes:
Primary Scope:

1. To provide a new underground water service entrance for the new foam system in hangar 4801 and 4802 and concrete pad and surrounding chain link fence for the new electrical transformer.

Secondary Scope:

N/A

b. The structural scope includes:
Primary Scope:

1. Building Summary

a) Building 4801
(1) Provide seismic bracing for new pipes (if required) to applicable design codes. Seismic bracing protection upgrades are not in this scope of work.

b) Building 4802
(1) Provide seismic bracing for new pipes (if required) to applicable design codes. Seismic bracing protection upgrades are not in this scope of work.

c) Building 4840
(1) Provide seismic bracing for new pipes (if required) to applicable design codes. Seismic bracing protection upgrades are not in this scope of work.

d) Building 4853
(1) Provide new concrete equipment pads for the new electrical generators.

Secondary Scope Option 1:

a) Building 4826
(1) Design seismic bracing for new pipes (if required) to applicable design codes. Seismic bracing protection upgrades are not in this scope of work.

Secondary Scope Option 2:

b) Building 4833
(1) Design seismic bracing for new pipes (if required) to applicable design codes. Seismic bracing protection upgrades are not in this scope of work.

c. The hazardous material abatement scope includes:
1. Remove and/or encapsulate existing lead paint that is located on existing structural members in hangars 4801 & 4802.

d. The architectural scope includes:
Primary Scope:

a) Building 4801
(1) The existing draft curtains in building 4801 do not adhere to current code requirements (5.17.3) and (5.17.5). In order for the building to adhere to current code regulations, the two (2) existing draft curtains will be removed and replaced with new draft curtains of the same material and in the same location, although the new panels will have more depth/height added to the panel to meet current code requirements. The new draft curtains length will need to be installed so that the draft curtain extends down so it is not less than 1/8 of the height from the floor to the roof or ceiling and/or 16 feet from the floor.

b) Building 4802
(1) The existing draft curtains in building 4802 appear to adhere to current code requirements (5.17.3) and (5.17.5) and will remain in their current location.

c) Building 4840
(1) There are no existing draft curtains in building 4840 and therefore will need to be installed to adhere to current code requirements (5.17.3) and (5.17.5). In order for the building to adhere to current code regulations, new draft curtains will be installed so each draft area will not exceed 7500 sf. The new draft curtains length will need to be extended so that the draft curtain extends down so it is not less than 1/8 of the height from the floor to the roof or ceiling and/or 16 feet from the floor.

Secondary Scope Option 1:

a) Building 4826
(1) The new draft curtains in building 4826 will be installed to current code requirements (5.17.3) and (5.17.5). In order for the building to adhere to current code regulations, one (1) new draft curtain will be installed so the draft area will not exceed 7500 sf. The new draft curtains length will need to be extended so that the draft curtain extends down so it is not less than 1/8 of the height from the floor to the roof or ceiling and/or 16 feet from the floor.

Secondary Scope Option 2:

a) Building 4833
(1) The existing draft curtain in building 4833 appears to not adhere to current code requirements (5.17.3) and (5.17.5) and will

need to be field verified for compliance. If the existing draft curtain does not comply then a new draft curtain shall be installed. In order for the building to adhere to current code regulations, two (2) new draft curtains will be installed so each draft area will not exceed 7500 sf. The new draft curtains length will need to be extended so that the draft curtain extends down so it is not less than 1/8 of the height from the floor to the roof or ceiling and/or 16 feet from the floor.
(2) A new 1-hr fire rated vestibule and Foam Pump Room will be constructed in the southwest corner of the hangar. The vestibule will be constructed at the hangars existing southwest exit door in order to provide a separate entrance into the new Foam Pump Room without having to access the hangar area. The new Foam Pump Room will be located directly beneath the existing mezzanine and will be framed with a new 1-hr fire rated wall/ceiling assembly as required by code. New 20 minute fire rated doors and frames will be installed as follows: One (1) new entrance door and frame for the new Vestibule, one (1) single and one (1) pair of entry doors for the Foam Pump Room.

e. The mechanical scope includes:
Primary Scope:

1. Building 4801 and 4802:
a) An intake damper assembly with a counterbalanced backdraft damper will be mounted on the roof to serve each foam generator mounted below the existing lay-in ceiling. An estimated 20'-0" length of 36" round supply air duct will be routed within the plenum from each intake assembly to each foam generator.
b) Gravity relief ventilators, each with a counterbalanced backdraft damper, will be mounted on the roof to relieve the building pressure when the foam generators are in operation.
2. Building 4840:
a) An intake damper assembly will be mounted on the roof to serve each foam generator that is to the underside of the roof. An estimated 5'-0" length of 36" round supply air duct will be routed from each intake assembly to each foam generator.
b) Gravity relief ventilators, each with a damper assembly, will be mounted on the roof to relieve the building pressure when the foam generators are in operation.

Secondary Scope Option 1:

1. Building 4826:
a) An intake damper assembly with a counterbalanced backdraft damper will be mounted on the roof to serve each foam generator that is to the underside of the roof. An estimated 5'-0" length of 36" round supply air duct will be routed from each intake assembly to each foam generator.
b) Gravity relief ventilators, each with a counterbalanced backdraft damper assembly, will be mounted on the roof to relieve the building pressure when the foam generators are in operation.

Secondary Scope Option 2:

1. Building 4833:
a) An intake damper assembly with a counterbalanced backdraft damper will be mounted on the roof to serve each foam generator that is to the underside of the roof. An estimated 5'-0" length of

36" round supply air duct will be routed from each intake assembly to each foam generator.
b) Gravity relief ventilators, each with a counterbalanced backdraft damper assembly, will be mounted on the roof to relieve the building pressure when the foam generators are in operation.
4. Foam room:
a) Provide a wall mounted exhaust fan capable of 10 air changes per hour. The wall penetration shall have a curtain type fire damper to meet the 1 hour fire rating.
b) A 30"x18" wall louver shall be provided opposite of the fan to allow 1100 cfm of ambient hangar air into the storage room. The wall penetration shall have a curtain type fire damper to meet the 1 hour fire rating.

f. The electrical scope includes:
Primary Scope:

1. The power for the fire pumps will be fed from existing Substation No. 16 located near McKay Avenue and Thompson Drive. Provide (2) medium voltage fused switch to tie into existing medium voltage electrical distribution system (12,470 volts). The two new independent 12,470 volt feeds will utilize one existing blank fused slot in each of existing buss #1 and buss #2. (Per NASA direction, these 2 feeders will travel in the same ductbank but different conduits. If there is an electrical failure on the primary one, the other feeder will be back-up through the automatic transfer switch. If both feeds fail there will not be any power to the fire pumps. The generators will supply power to buss #1 and buss #2 in the event that both source #1 and source # 2 lose power. The generators will not turn on if only the feeds from buss #1 or buss #2 in substation 16 to the automatic transfer switch fail. If either source #1 or source #2 fail, then the other source will provide power to the buss that failed through a tie-breaker. Both existing 34.5KV to 12.47KV transformers from source #1 and source #2 were sized to handle both buss loads in the event that one failed. The important thing to realize is that the generators will not turn on except when both sources lose power (this is per NASA directive). If there is a physical devastation in the underground where both feeders are physically damaged then there will be no power even when the generators turn on).
2. Two new independent 12,470 volt feeders (one from buss #1 and one from buss #2 that emanate in substation 16) will travel in two existing independent four inch conduits in the same existing duct bank from substation 16 to the existing man-hole (MH-16) just outside existing building 4853 (fire pump house). This will be done for redundancy as NASA has stated that they have lost existing feeders to existing buildings in the past. The size of the new wire will be 2/0. This new wire is oversized for the primary but this will reduce the inventory that NASA has to stock (2/0 is a normal size for NASA)
3. There will be new trenching from the existing man-hole (MH-16) just outside of building 4853 to a new concrete pad placed at the NE corner of building 4853. The exact coordinates for this new concrete pad will have to be verified by NASA. The new trench will contain at least two new four inch conduits encased in concrete with new warning tape with a tracer placed on top of the concrete. NASA has verified they want 2 new 4 inch spare conduits with a pull string in this new concrete encased duct bank.

4. The new concrete pad will house a new transformer and a new automatic transfer switch (ATS). The transformer shall be sized for (3) fire pumps to operate simultaneously, 2500KVA, 12,470 volt primary - 480Y/277 volts, 3 phase, 3wire secondary There will be a new chain link fence at least 8 feet high with a swing gate around the perimeter of the new concrete pad to protect this new gear and to keep unauthorized personnel out of the arc flash area. NASA is to verify if bollards are needed around this new equipment. New high voltage warning signs will be placed on each side of this new fence.
5. There will be (5) 480 volt feeds in a new trench from the new transformer on the new concrete pad to the inside of existing building 4853. These new 480 volt feeds will supply power to the four new electric fire pump controllers (one new fire pump will always be a spare) and a jockey pump housed within building 4853. NASA has verified this new 480 volt feed does not need to be concrete encased. There will also be new warning tape with a tracer placed on top the new conduit in this new trench that houses this new 480 volt feeder. NASA needs to verify if they want spare conduit(s) in this trench (diameter and quantity) with a pull string.

Secondary Scope Option 1:

a. Building 4826
1. Provide electricity for replacement fire alarm panel by utilizing existing circuit made available from demolition of existing fire alarm panel.

b. System Reliability Concerns
2. Continuous utility performance - electrical power to new electric fire pumps shall be connected to the DFRC power system. Primary tap and switch and medium voltage transformers, fed from existing system (12,470 volts) will be required.

c. Equipment monitoring requirements
3. Provide sub meters (smart meters) to monitor system voltage and loads. Set alarm points to warn when conditions indicate potential problems. (e.g. voltage fluctuations, overloading, etc.).

d. Long-Lead/Critical Equipment & Materials
4. Primary/medium-voltage electrical equipment: switches, transformers can be long lead items unless arrangements have been made with a supplier (or a local utility company).

Secondary Scope Option 2:

Building 4833
1. Provide electric lighting and electric receptacles for added room housing foam storage tanks. Provide electricity for exhaust fan for this room. Provide electricity for replacement fire alarm panel in hangar.

g. The fire protection scope includes:
Primary Scope:

1. Site Supply/Building 4853
a) Fire Pumps
(1) Demolish (4) existing 3000 gpm @ 145 psi diesel pumps, pads,

and equipment within B4853.
(2) Provide (4) horizontal, split case electric pumps, and concrete pads arranged in parallel in the existing fire pump building B4853. Each pump to be 4000 gpm @ 145 psi rated, 600 hp.
(3) Existing 600,000 gallon water storage tank located near B4853 to be refurbished as a part of a different project. Fill for this tank will be modified between the domestic and fire main connections as a part of this project so that the primary fill will be from the domestic loop. Manual fill from the fire main loop is backup as needed to fill the tank, and the pumps will need to be shut down in order to allow the fire tanks from the hill to fill the 600,000 gallon tank located by the pump house B4853.

b) Fire Alarm/Detection
(1) Connect high/low level tank sensors from the existing 600,000 gallon water storage tank to the fire alarm panel in B4853 for monitoring.
(2) The two (2) existing fire alarm control panels serving this building are not interconnected and monitoring of existing system/equipment is limited based on configuration. Replace both existing panels with one (1) new panel for the fire alarm within the pump room, monitoring of the new fire pumps and monitoring of the tank.
(3) Provide connections necessary to monitor new fire pumps and auxiliary equipment.
2. B4801
a) Fire Sprinkler
(1) Overhead closed head foam-water single interlock preaction system currently to be converted to solely water based single interlock preaction system.
(2) Small modifications are required to the existing sprinkler layout as necessary. Refer to drawings for additional information.
(3) Add sprinkler protection to 12 existing skylights.
(4) Modify sprinkler riser configuration for all four (4) fire sprinkler risers.

b) Low Level High Expansion Foam
(1) Demolish existing (2) 1000 gallon, 3% AFFF foam tanks (2000 gallon total).
(2) Demolish (2) existing 30hp, 1755 rpm, 3 phase motors/pumps and pads for foam system.
(3) Demolish existing foam monitor nozzles around hangar.
(4) Provide (2) new horizontal 400 gallon foam bladders tanks for the high expansion foam suppression system.
(5) Provide foam proportioner and (1) new 6" preaction valve.
(6) Provide (5) water powered foam generators at the ceiling level.

c) Seismic bracing protection upgrades for new and/or existing piping as required (approximately 15% of hangar assumed).

d) Fire Alarm/Detection
(1) Replacing 2 old Notifier fire alarm/releasing panels with one new SimplexGrinnell 4100ES FACP to control preaction systems and foam monitoring/activation for the hangars. This shall include required suppression release peripherals necessary for each system.
(2) Leave existing cross zoned conventional detection in space and connect to new panel.

(a) Reprogram existing detection as needed to correspond with the draft curtain and preaction system configuration.
(3) Remove all abandoned in place UV/IR detectors throughout hangar and associated amber strobes.
(4) Add pull stations throughout hangar for preaction manual release and low level foam manual release.
(5) Add abort switches throughout hangar for foam abort.
(6) Remove all existing red beacon lights and replace with blue beacon lights for foam system activation notification.
(7) Provide equipment and connections for all fire sprinkler and foam suppression monitoring demolition and new work.
(8) Provide as an alternate bid option to remove existing conventional detection throughout hangar space and provide cross zoned linear heat detection spaced at 30 ft. on center, nominally. Provide equipment and controls necessary to interface linear heat detection with preaction releasing panel.

3. B4802
a) Fire Sprinkler
(1) Overhead closed head foam-water single interlock preaction system currently to be converted to solely water based single interlock preaction system.
(2) Minor modifications are required to existing sprinkler layout is necessary. Refer to drawings for additional information.
(3) Modify sprinkler riser configuration for all ten (10) fire sprinkler risers.

b) Low Level High Expansion Foam
(1) Demolish (2) existing 75hp, 1775 rpm, 3 phase motors/pumps and pads for foam system. Existing foam pump #1 is currently out of service.
(2) Demolish existing (2) 2705 gallon, 3% AFFF foam tanks (5410 gallon total).
(3) Demolish existing foam monitor nozzles around hangar.
(4) Provide (2) new horizontal 800 gallon foam bladders tanks for the high expansion foam suppression system.
(5) Provide foam proportioner and (1) new 6" preaction valve.
(6) Provide (9) water powered foam generators at the ceiling level.

c) Seismic bracing protection upgrades for new and/or existing piping as required (approximately 15% of hangar assumed).

d) Fire Alarm/Detection
(1) Replacing all old Notifier fire alarm/releasing panels with one new SimplexGrinnell 4100ES FACP to control preaction systems and foam monitoring/activation for the hangars. This shall include required suppression release peripherals necessary for each system.
(2) Leave existing cross zoned conventional detection in space and connect to new panel.
(a) Reprogram existing detection as needed to correspond with the draft curtain and preaction system configuration.
(3) Remove all abandoned in place UV/IR detectors throughout hangar and associated amber strobes.
(4) Add pull stations throughout hangar for preaction manual release and low level foam manual release.
(5) Add abort switches throughout hangar for foam abort.
(6) Remove all existing red beacon lights and replace with blue

beacon lights for foam system activation notification.
(7) Provide equipment and connections for all fire sprinkler and foam suppression monitoring demolition and new work.
(8) Provide as an alternate bid option to remove existing conventional detection throughout hangar space and provide cross zoned linear heat detection spaced at 30 ft. on center, nominally. Provide equipment and controls necessary to interface linear heat detection with preaction releasing panel.

4. B4840
a) Fire Sprinkler System
(1) Demolish (3) diesel horizontal, split case pumps and pads at building B4840, each 3000 gpm @ 80 psi, 8" single stage, 1770 rpm. Demolish 375 gallon fuel oil tanks, and concrete enclosures for each pump. Each tank will need to be pumped and cleaned prior to removal from site.
(2) Overhead open head foam-water deluge system currently to be converted to solely water based single interlock preaction system.
(3) Reroute riser main drain piping from (5) existing risers to discharge at exterior of building.
(4) Tie in existing service entrance pipe to existing main serving building to bypass existing pumps to be removed. Refer to drawings for additional information.
(5) Small modifications to existing sprinkler layout is necessary. Refer to drawings for additional information.
(6) Replace all open head sprinklers within hangars to standard closed type sprinklers.
(7) Modify sprinkler riser configuration for all (5) fire sprinkler risers.

b) Low Level High Expansion Foam
(1) Demolish (2) 40hp, 1765 rpm, 3 phase motors/pumps and pads for foam system.
(2) Demolish existing (2) 2220 gallon, 3% AFFF foam tanks (4440 gallon total).
(3) Provide (2) new horizontal 500 gallon foam bladders tanks for the high expansion foam suppression system.
(4) Provide foam proportioner and (1) new 6" preaction valve.
(5) Bays 1, 2, and 3
(a) Provide (6) water powered foam generators at the ceiling level.
(b) Provide (3) new hand hose stations throughout hangar.
(6) Bays 4 and 5
(a) Provide (5) water powered foam generators at the ceiling level.
(b) Provide (3) new hand hose stations throughout hangar.
(7) Bay 6
(a) Provide (4) water powered foam generators at the ceiling level.
(b) Provide (2) new hand hose station in hangar.

c) Seismic bracing protection upgrades for new and/or existing piping as required (approximately 15% of hangar assumed).

d) Fire Alarm/Detection
(1) Replacing 5 old Notifier fire alarm/releasing panels and 4 old Simplex 4100U panels located throughout the hangars and pump room with one new SimplexGrinnell 4100ES FACP to control all preaction systems and foam monitoring/activation for the hangars.

New panel to be connected to the existing Simplex admin panel located in existing pump room for monitoring and reporting to Post 1. This shall include required suppression release peripherals necessary for each system.
(2) Leave existing cross zoned conventional detection in space and connect to new panel.
(a) Reprogram existing detection as needed to correspond with the draft curtain and preaction system configuration.
(3) Remove all abandoned in place UV/IR detectors throughout hangar and associated amber strobes.
(4) Add pull stations throughout hangar for preaction manual release and low level foam manual release.
(5) Add abort switches throughout hangar for foam abort.
(6) Remove all existing red beacon lights and replace with blue beacon lights for foam system activation notification.
(7) Provide equipment and connections for all fire sprinkler and foam suppression monitoring demolition and new work.
(8) Provide as an alternate bid option to remove existing conventional detection throughout hangar space and provide cross zoned linear heat detection spaced at 30 ft. on center, nominally. Provide equipment and controls necessary to interface linear heat detection with preaction releasing panel.

Secondary Scope Option 1:

1. B4826
a) Fire Sprinkler
(1) Overhead closed head foam-water single interlock preaction system currently to be converted to solely water based single interlock preaction system.
(2) Modifications are required to the existing sprinkler system, including adding and removing piping. Refer to drawings for additional information.
(3) A portion of the existing sprinkler system is wet and will be converted to a preaction system with (1) new 6" preaction valve. Refer to drawings for additional information.
b) Low Level High Expansion Foam
(1) Demolish the existing foam monitors and associated tanks, piping, hangers, and valves.
(2) Provide foam proportioner and (1) new 6" preaction valve.
(3) Provide (2) new horizontal 500 gallon foam bladders tanks for the high expansion foam suppression system.
(4) Provide (6) water powered foam generators at the ceiling level.
c) Seismic bracing protection upgrades for new and/or existing piping as required (approximately 15% of hangar assumed).
d) Fire Alarm/Detection
(1) Replacing 1 old Simplex fire alarm panel and 2 old Notifier releasing panels with one new SimplexGrinnell 4100ES FACP to control preaction systems and foam monitoring/activation for the hangars. This shall include required suppression release peripherals necessary for each system.
(2) Leave existing cross zoned conventional detection in space and connect to new panel.
(a) Reprogram existing detection as needed to correspond with the draft curtain and preaction system configuration.
(3) Remove all abandoned in place UV/IR detectors throughout hangar and associated amber strobes.
(4) Add pull stations throughout hangar for preaction manual

release and low level foam manual release.
(5) Add abort switches throughout hangar for foam abort.
(6) Remove all existing red beacon lights and replace with blue beacon lights for foam system activation notification.
(7) Provide equipment and connections for all fire sprinkler and foam suppression monitoring demolition and new work.
(8) Provide as an alternate bid option to remove existing conventional detection throughout hangar space and provide cross zoned linear heat detection spaced at 30 ft. on center, nominally. Provide equipment and controls necessary to interface linear heat detection with preaction releasing panel.

Secondary Scope Option 2:

1. B4833
a) Fire Sprinkler
(1) Overhead open head deluge system currently to be converted to solely water based single interlock preaction system.
(2) Minor modifications are required to the existing sprinkler layout is necessary. Refer to drawings for additional information.
(3) Modify sprinkler riser configuration for two (2) fire sprinkler risers.
(4) Replace all open head sprinklers within hangars to standard closed type sprinklers.
(5) Add sprinkler coverage to new foam room.
b) Low Level High Expansion Foam
(1) Provide foam proportioner and (1) new 6" preaction valve.
(2) Provide (2) new horizontal 500 gallon foam bladders tanks for the high expansion foam suppression system. Foam tanks to be located within new 1-hr rated room on hangar floor as shown on the drawings.
(3) Provide (9) water powered foam generators at the ceiling level.
(4) Provide (3) new hand hose stations throughout hangar.
c) Seismic bracing protection upgrades for new and/or existing piping as required (approximately 15% of hangar assumed).
d) Fire Alarm/Detection
(1) Replacing 2 old Notifier fire alarm/releasing panels with one new SimplexGrinnell 4100ES FACP to control preaction systems and foam monitoring/activation for the hangars. This shall include required suppression release peripherals necessary for each system.
(2) Leave existing cross zoned conventional detection in space and connect to new panel.
(a) Reprogram existing detection as needed to correspond with the draft curtain and preaction system configuration.
(3) Remove all abandoned in place UV/IR detectors throughout hangar and associated amber strobes.
(4) Add pull stations throughout hangar for preaction manual release and low level foam manual release.
(5) Add abort switches throughout hangar for foam abort.
(6) Remove all existing red beacon lights and replace with blue beacon lights for foam system activation notification.
(7) Provide equipment and connections for all fire sprinkler and foam suppression monitoring demolition and new work.
(8) Provide as an alternate bid option to remove existing conventional detection throughout hangar space and provide cross zoned linear heat detection spaced at 30 ft. on center, nominally. Provide equipment and controls necessary to interface

linear heat detection with preaction releasing panel.

1.1.1 Separate Construction Phases

The contractor shall perform the work in Five (5) distinct and separate phases. Four(4) of the phases are optional. The Contractor shall perform work on one phase at a time. After completion of each phase of construction a final inspection will be performed by the Government prior to work commencing in the next phase. Once the work in one phase is completed and accepted by the Government, the Contractor will be issued a Notice to Proceed for the next phase establishing start and completion dates reflecting the number of days allowed per phase as shown in Paragraph 1.5 " Phased Construction Schedule".

The order of phase execution is:
Phase 1 - Pump House 4853 and hangar B4826. Pump House 4853 shall be on-line prior to commencing construction in hangar 4840.

Phase 2 - Hangar 4840 shall be scheduled as follows:
1. Bay's 1, 2, and 3
2. Bay's 4 and 5
3. Bay 6

Phase 3 - hangar 4801

Phase 4 - hangar 4802

Phase 5 - hangar 4833

The general sequence of operations within a phase is as follows:
Building 4853 is required to be completed, inspected, operational and on-line prior to construction work beginning in hangar 4840.

Building 4840 Pump Room - A bypass water supply valve shall be installed into the system prior to disconnecting and/or removing the existing diesel engines and foam bladder tanks.

1.1.2 Base Bid and Options

The contract is structured as base bid work and 2 options.

Base Bid - The base bid work includes Hangar 4801, 4802, 4840 and Pump House 4853.

Option 1 - Option 1 work includes Hangar 4826.

Option 2 - Option 2 work includes Hangar 4833.

1.2 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.

ASTM INTERNATIONAL (ASTM)

ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

1.3 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Environmentally preferable products" have a lesser or reduced effect on the environment in comparison to conventional products and services. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product.

b. "Indoor environmental quality" is the physical characteristics of the building interior that impact occupants, including air quality, illumination, acoustics, occupant control, thermal comfort, daylighting, and views.

c. "Operational performance" is the functional behavior of the building as a whole or of the building components.

d. "Sustainability" is the balance of environmental, economic, and societal considerations.

1.4 CONTRACT DRAWINGS

Drawings and documents that accompany this specification are a part thereof, and are listed in section 00 01 15 List of Drawings.

Digital drawings and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished. The Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.5 PHASED CONSTRUCTION SCHEDULE AND PERIOD OF PERFORMANCE

Within the contract period of performance of 616 days, including the base bid and all options, the Contractor shall commence and complete the work in phases including all required submittals. Liquidated damages (LDs) will be assessed for each phase of work for Contractor delays in the amount of $ per day per phase.

The following reflects the number of calendar days that will be allowed for construction per phase. Items marked with an asterisk reflect option items which may or may not be awarded. A minimum of 14 days will be required between each phase of Contractor work.

Task	Calendar Days
NTP-Mobilize Site	21
Construction (No Phases)	616
Construct Primary Scope	406
Between phases	14

*Construct Option 1	84
Between phases	14
*Construct Option 2	98
Etc.	
Total	616

All fire protection systems are required to be tested and commissioned prior to commencing work in the next scheduled hangar. The phasing schedule is subject to change and shall be determined by the Contracting officer. Any work interfering with Armstrong activities shall be accomplished after normal work hours. Interference can be, but is not limited to excessive noise, dust, obstruction to typical pedestrian traffic, and obstruction to work area access.

1.6 WORK HOURS

All Construction work under this contract shall be performed during normal duty hoursfrom 6:00a.m. to 5:00p.m. (Normal duty hours are defined in Section 01 14 00 "WORK RESTRICTIONS".) Weekends and Government holidays are restricted for work unless otherwise directed by Contracting Officer.

The Contractor shall allow for a maximum of ten (10) days per year where construction activity is not permitted because NASA facilities are closed.

1.7 REUSED PROPERTY

Equipment, material or furniture designated to be reused shall remain the property of the Government and relocated in coordination with the Contracting Officer who will coordinate with the Industrial Property Management Specialist.

Material and equipment that will be removed and reused include(s):

DESIGNATION NO.	DESCRIPTION	QUANTITY
Hangar 4801	acoustical ceiling panels	4,486 sf
Hangar 4802	acoustical ceiling panels	11,456 sf
Hangar 4801	Existing light fixtures	As required
Hangar 4802	Existing light fixtures	As required
Hangar 4801	Existing ceiling speakers	As required
Hangar 4802	Existing ceiling speakers	As required

1.8 REQUIRED OPERATIONAL SYSTEMS AND UTILITIES

The Contractor shall maintain and operate existing Fire Alarm/Fire Protection Services system to allow uninterrupted services during the period of construction. All modifications shall be performed in a manner in which the system can be operated effectively during normal duty hours and provide normal services to building occupants.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
07/07

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contact List of Key Personnel; G

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Activity Regulations

Contractor personnel employed on the Activity shall become familiar with and obey Activity regulations including safety, fire, traffic and security regulations according to Section 01 35 14.11 40 "AFRC Safety Requirements." Contractor personnel shall keep within the limits of the work and avenues of ingress and egress. To minimize traffic congestion, delivery of materials shall be outside of peak traffic hours (Peak traffic hours are 6:30 to 8:00 a.m. and 3:30 to 5:00 p.m.) unless otherwise approved by the Contracting Officer. Contractor personnel shall not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.2.1.1 MATERIAL AND EQUIPMENT

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site. The Government will not accept deliveries on behalf of the Contractor or Subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site. The Contractor shall not have any material or equipment deliveries made to the AFRC shipping and receiving warehouse. The Contractor shall use the following address:

(Name of Contractor's firm or company)
P.O.C. (Name of Contractor's superintendent or other employee)
Repair Aircraft Hangar Fire Protection Systems
NASA Armstrong Flight Research Center
Edwards, CA 93524

The Contractor shall protect and preserve materials, supplies, and equipment of every description, including property which may be Government-furnished or Government-owned. Material to be salvaged and reinstalled by the Contractor shall be protected during removal and stored to prevent damage. Only material and construction equipment designated for performance of contract work may be stored at the construction site or located in Government-controlled areas.

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the

manufacture of the products. Material and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.

1.2.1.2 Subcontractors and Personnel Contacts

Contractor shall furnish a contact list of key personnel including e-mail addresses and telephone numbers. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.2.1.3 Identification Badges

Identification badges will be furnished without charge. Application for and use of badges will be as directed. Contractor shall submit for approval on NASA Form DFRC-735 or DFRC-736, at least 15 days prior to the desired date of entry, a list of personnel who require entry into Government property to perform work on the project. Furnish a completed EMPLOYMENT ELIGIBILITY VERIFICATION (DHS FORM I-9) form for all personnel requesting badges. This form is available at http://www.uscis.gov/sites/default/files/files/form/i-9.pdf. Immediately report instances of lost or stolen badges to the Contracting Officer.

1.2.1.4 Personnel Entry Approval

Failure to obtain entry approval will not affect the contract price or time of completion.

1.2.1.5 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installations under the cognizance of NASA except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.2.2 NORMAL DUTY HOURS

Normal duty hours are from 6:00 am to 5:30 pm Monday through Friday the first week, and then from 6:00 am to 5:30 pm Monday through Thursday the second week, excluding federal holidays. Armstrong Flight Research Center is currently operating under this flexible work schedule, permitting employees to work 80 hours in 9 days (known as a 9/80 schedule) and have a nonwork day every other Friday. The Center is closed every other Friday. The contractor's work shifts shall take place as described in Section 01 11 00, except as requested and approved per paragraph "Work Outside Normal Duty Hours" below.

1.2.2.1 Work Outside Normal Duty Hours

Work outside normal duty hours requires Contracting Officer approval. Make application 14 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside normal duty hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.2.3 OCCUPANCY OF PREMISES DURING CONSTRUCTION

The buildings will be occupied during performance of work under this Contract. Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways. Government personnel will be allowed in the construction area to perform routine or emergency maintenance on building systems and equipment. This includes communication, electrical, mechanical, and fire protection systems.

1.3 ENVIRONMENTAL CONSIDERATIONS

The Edwards AFB property, which NASA shares, is on the National Priorities List (NPL, or Superfund) due to known areas of soil and groundwater contamination. Known contamination in soil has been cleaned up, and known contamination in shallow groundwater is under treatment but not yet cleaned up. The Contractor shall be aware that all intrusive activities that require a dig permit (greater than 6" deep) may also require vapor monitoring and use of Personal Protective Equipment (PPE) when work is occurring within these areas, unless waived by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 20 00.00 20

PRICE AND PAYMENT PROCEDURES
02/10

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of Values; G

SD-11 Closeout Submittals

Contractor's Invoice shall be submitted in accordance with Paragraph "CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT"

1.2 SCHEDULE OF VALUES

1.2.1 Data Required

Within 15 calendar days after Notice of Award, the Contractor shall prepare and deliver to the Contracting Officer a schedule of values for approval. The Schedule of Values shall consist of a detailed breakdown of each contract activity. The value of each activity shall be identified as a percentage of the total contract value, and shall correlate with the activities in the Project Schedule.

Contracting Officer will determine whether items in the Schedule of Values are appropriate. Progress payments shall be based on the approved Schedule of Values.

1.2.2 Schedule Instructions

Payments will not be made until the Schedule of Values has been submitted to and accepted by the Contracting Officer.

1.3 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.3.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause FAR 52.232-27. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies. Requests for payment in accordance with the terms of the contract shall consist of:

a. The Contractor's invoice on the form furnished by the Contracting Officer for this purpose, shall show in summary form the basis for arriving at the amount of the invoice.

b. The contract performance statement on the form furnished by the Contractor for this purpose and consistent with the approved Schedule of Values, shall show in detail the estimated percentage of completion

for each Definable Feature of Work (DFOW). The format, content, and number of copies required will be prescribed by the Contracting Officer and will be subject to his/her approval.

c. Furnish a certificate to the CO with each payment request attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

d. The Estimate for Voucher, showing in detail the percentage of completion for each of the construction activities listed on the Schedule of Values.

e. Updated Project Schedule and any reports required by the contract.

g. Contractor Safety Self-Evaluation Checklist

h. Weekly Certified Payroll Report

i. Solid Waste Disposal Report

j. Other supporting documents as requested

k. For Final Payment: All closeout submittals must be received prior to final payment. A final invoice and the Contractor's Final Release is the Contractor's request for final payment, including completed As-Built Drawings. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary or official designee shall certify the Final Release.

No separate payments will be made for protection efforts necessitated by the safety provisions.

1.4 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
02/10

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Electronic Mail (E-Mail) Address; G

View location map; G

Progress and completion pictures; G

SD-04 Samples

Color boards; G

1.2 COLOR BOARDS

Submit five sets of color boards within 90 calendar days after Contract Award. Each set of boards shall include samples of colors and finishes of interior surfaces, such as walls, floors, and ceilings. The samples shall be presented on 8 by 10-1/2 inches boards (modules) with a maximum spread of 24 by 31-1/2 inches for foldouts. Modules shall be designed to fit in a standard loose-leaf, three-ring binder. Where special finishes such as architectural concrete, carpet, or prefinished textured metal panels are required, samples not less than 12 inches square shall be submitted with the board. If more space is needed, more than one board per set may be submitted. The Contractor shall certify that he has reviewed the color samples in detail and that the color samples are in strict accordance with contract drawings and specifications, except as may be otherwise explicitly stated. Submittal of color samples shall not relieve the Contractor of the responsibility to submit samples required elsewhere herein.

1.3 VIEW LOCATION MAP

Submit to the Contracting Officer, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.4 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take regular digital photographs throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit with the monthly invoice one set of digital photographs on a CD-R, cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Photographs for each month shall be in a separate monthly

directory and each file shall be named to indicate its location on the view location sketch. The view location sketch shall also be provided on the CD as digital file. All file names shall include a date designator. Cross reference submittals in the appropriate daily report. Photographs shall be provided for unrestricted use by the Government.

1.5 SUPERVISION

Provide at least one (1) qualified Project Manager and one (1) qualified on-site Project Superintendent. The Project Manager must have a minimum of 10 years experience as a Project Manager or Superintendent on projects like this contract or similar in size and complexity. The Project Superintendent must have a minimum of 10 years' experience as a Superintendent on projects similar in size and complexity.

Project Manager and on-site Project Superintendent shall complete the U.S. Army Corps of Engineers course entitled "Construction Quality Management for Contractors" prior to the start of construction.

The Project Manager in this context shall mean the individual with the responsibility for the overall management of the project and the Project Superintendent shall mean the individual with the responsibility for production. Both the Project Manager and Project Superintendent are subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, 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 for excess costs or damages by the Contractor.

Approval of Project Manager and on-site Project Superintendent is required prior to start of construction. Provide resumes for the proposed Project Manager and on-site Project Superintendent describing their experience with references and qualifications to the Contracting Officer for approval. The Contracting Officer reserves the right to interview the proposed Project Manager and on-site Project Superintendent at any time in order to verify the submitted qualifications.

1.6 PROJECT MEETINGS

1.6.1 Preconstruction Conference

The Contractor shall attend a preconstruction conference scheduled by the Contracting Officer. Work shall not commence prior to the conference. Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, quality control and the location of the Contractor's office.

1.6.2 Weekly Project Meetings

The Contractor shall attend weekly project meetings scheduled by the Government. Discussion shall address at a minimum: safety issues, quality control, submittals, progress schedule, schedule of submittals, as-built drawings, deficiencies, material delivery, permits, equipment delivery, invoices, potential factors of delay, request for information (RFIs), changes, and functional tests.

1.15 PARTNERING

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership within the Project Team whose members are from the Government, the Contractor and their Subcontractors. Key personnel from NASA, the Contractor and Subcontractors, and the Designer of Record will be invited to participate in the Partnering process. The Partnership will draw on the strength of each organization in an effort to achieve a project that is without any safety mishaps, conforms to the Contract, and stays within budget and on schedule.

The Contracting Officer will provide Information on the Partnering Process and a list of key and optional personnel who should attend the Partnering meeting.

1.7 Informal Partnering

The Contracting Officer will organize the Partnering Sessions with key personnel of the project team, including Contractor personnel and Government personnel.

The Initial Partnering session should be a part of the Pre-Construction Meeting. Partnering sessions will be held at a location agreed to by the Contracting Officer and the Contractor (typically a conference room provided by NASA or the Contractor).

The Partners will determine the frequency of the follow-on sessions.

1.8 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft Office, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple email addresses will NOT be allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01.00 10

PROJECT SCHEDULE
08/08

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2005-10	(2005) Scheduling Requirements for Testing of Mechanical Systems in Construction Contracts

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Schedule; G

1.3 QUALIFICATIONS OF PROJECT SCHEDULER

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports. The authorized representative shall be experienced in scheduling projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of construction is 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. Provide a schedule that is a forward planning as well as a project monitoring tool.

3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. The schedule shall be cost loaded and activity coded. The schedule will provide the basis for all progress payments. The project schedule shall be capable of showing percent complete for each activity.

3.1.2 Schedule Status Reports

Provide a Schedule Status Report on at least a monthly basis. If the Contracting Officer determines that the Contractor has fallen behind the approved schedule, the Contracting Officer may require the Contractor to take steps necessary to improve its progress without additional cost to the Government.

3.2 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the Project Schedule shall be capable of meeting all requirements of this specification.

3.2.1 Level of Detail Required

Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.2.1.1 PROGRESS SCHEDULE REQUIREMENTS

The Contractor shall prepare and submit to the Contracting Officer for approval a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the major salient features of the work, including acquiring materials and equipment. The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. The Contractor shall:

a. Submit the progress chart in one reproducible format and three copies to the Contracting Officer for approval no later than 15 days after notice to proceed.

b. Prepare the progress chart in the form of a bar chart utilizing a form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

1. Break out by major headings for each primary work activity.

2. A line item break-out under each major heading sufficient to track the progress of the work.

3. A line item showing contract finalization tasks which include punch list, clean-up, O&M data, and As-Built drawings. These activities are to show no associated costs.

4. The estimated percentage weight of total contract value for each line item on the chart. This shall be consistent with the Schedule of Values.

5. Separate line items for submittal preparation and reviews. These shall be consistent with the "Schedule of Submittals" required in Section 01 45 00.10 40, "CONTRACTOR QUALITY CONTROL". Submittal preparation and reviews are to show no associated costs.

6. Separate line items for mobilization and demobilization.

d. Update the progress schedule in 3 copies every 30 days throughout the contract performance period. The updated schedule shall be submitted with the monthly payment request.

3.2.1.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have durations greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.2.1.3 Procurement Activities

The schedule must include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

3.2.1.4 Mandatory Tasks

The following tasks must be included and properly scheduled if in scope:

b. Submission of mechanical/electrical/information systems layout drawings.

c. Submission and approval of O & M manuals.

d. Submission and approval of as-built drawings.

e. Submission and approval of NASA Form NF1046 "Transfer and/or Notification of Acceptance of Accountability of Real Property" data.

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

g. Submission of TAB specialist design review report.

h. Submission and approval of fire protection specialist.

i. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with ECB 2005-10.

j. Air and water balancing.

k. HVAC commissioning.

l. Controls testing plan submission.

m. Controls testing.

n. Performance Verification testing.

o. Other systems testing, if required.

p. Submission and approval of installed equipment lists.

q. Final inspection.

3.2.1.5 Government Activities

Show Government and other agency activities that could impact progress. 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.

3.2.2 Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is received by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7-day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Note as Weather Sensitive Installation those activities that are weather sensitive. Durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.2.2.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" (or NTP) with a start date equal to the date that the NTP was acknowledged, and a zero day duration.

3.2.2.2 Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project" with an end date equal to the contract completion date for the project, and with a zero day duration. The schedule shall have no constrained dates other than those specified in the contract.

3.2.2.3 Early Project Completion

In the event the Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.2.3 Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for construction; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.3 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data Compact Disk (CD), reports, and schedules required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.3.1 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 5 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer.

3.3.2 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will 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 judgment 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.

3.3.3 Phased Construction Schedule

Include in Project Schedule submissions, and update submissions, all Construction Phase Scheduling as required in 01 11 00 SUMMARY OF WORK. Include Contractor's plan to address any issues that put the schedule at risk.

3.4 SUBMISSION REQUIREMENTS

Submit the following items for the Initial Schedule and every Periodic Schedule Update throughout the life of the project:

3.4.1 Data Delivery

Provide digital files containing the project schedule in the original scheduling software format, and PDF format. Each delivery shall also contain all previous update schedules. File medium shall be CD or other digital media approved by Contracting Officer. Label each CD indicating the type of schedule (Initial or Periodic Update), full contract number, Data Date and project title. Each schedule shall have a unique file name as determined by the Contractor.

3.4.2 Narrative Report

Provide a Narrative Report with the Initial and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, 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 communicate 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. Identify and explain why any activities that, based on their planned dates, should have either started or finished during the update period but did not.

3.4.3 Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. 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.

3.4.4 Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports 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 Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

3.4.4.1 Activity Report

A list of all activities sorted according to activity number.

3.4.4.2 Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.4.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.4.4.4 Earnings Report by Activity

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has furnished a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by activity number. This report shall: sum all activities and provide a percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, and Percent Complete (based on total contract value).

3.4.5 Network Diagram

The network diagram is required for the Initial and Periodic Updates. 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:

3.4.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated percent complete on the diagram.

3.4.5.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.4.5.3 Critical Path

Clearly show the critical path.

3.4.5.4 Banding

Organize activities as directed 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 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining percent complete. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intends to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting.

3.5.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION

REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.5.2 Status of Activities

Update information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting.

3.5.2.1 Start and Finish Dates

Accurately show the status of the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.5.2.2 Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining Durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.5.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government final inspection not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government final inspection.

3.6 WEEKLY PROGRESS MEETINGS

a. Meet weekly with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the planned progress and to review planned activities for the upcoming two weeks. The then-current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart showing Total Float and Sorted by Early Start Date, with a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by

responsible party and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date, are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately.

3.7 OWNERSHIP OF FLOAT

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

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
06/10

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to the start of construction work on-site, such as:

List of proposed products

Construction Progress Schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of Values

Accident Prevention Plan

Activity Hazard Analysis for Mobilization

Quality Control (QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended

product warranties.

SD-04 Samples

Fabricated or un-fabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accordance with specified requirements.

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Safety Data Sheet (SDS) concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to operate and maintain equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual, database, or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings, warranty certificates, training records, asset / equipment list with cost breakdown, and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Updated Submittal Register; G

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Contractor QC Approved (Submittals without a "G" designation)

Contractor shall review all construction submittals for quality control. When Government approval is not required, Contractor shall be held responsible for submittal approval and construction per contract documents.

1.3.2 Government Approved (Submittals with a "G" designation)

Government approval is required for critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer.

1.4 PREPARATION

1.4.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the Contracting Officer. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section.

1.4.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review, and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

e. Section number of the specification section and applicable drawing numbers by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

1.4.2.1 Digital Submittals

In addition to providing the required quantity of hard copies of administrative, informational, material, O&M, and as-built drawing submittals, the contractor shall also include one electronic copy of each submittal. The electronic copy shall be in both an original editable file format (when created by the Contractor) and PDF format and submitted on non-rewritable optical media (CD or DVD) at the same time as the hard copy submittal. If material is copyrighted, written permission from the copyright holder for digital replication of O&M Manuals shall also be included. Red-lined as-built drawings shall be scanned to PDF in the same paper size as the original.

1.4.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Present A4 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled, "Identifying Submittals," of this section.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication references.

1.4.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal,

military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.4.5 Format of SD-04 Samples

Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to A4 8 1/2 by 11 inches.

c. Sample of Materials Exceeding A4 8 1/2 by 11 inches: Cut down to A4 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit

sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at time of use.

Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final cleanup of project.

When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.4.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.4.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.4.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements as specified in each section.

1.4.9 Format of SD-11 As-Built Drawings

Comply with the requirements as specified in each section.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of SD-02 Shop Drawings

Submit three (3) copies of submittals of shop drawings requiring review and approval by Contracting Officer.

1.5.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.5.3 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials, where directed.

1.5.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.5.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.5.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit three copies of O&M Data to the Contracting Officer for review and approval.

1.5.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit three sets of administrative submittals.

1.6 VARIATIONS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 titled, "Specifications and Drawings for Construction," and will be considered where advantageous to the Government.

1.6.1 Considering Variations

Discussion with Contracting Officer prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

1.6.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the written analysis. If lower cost is a benefit, Contractor shall also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation. If submittal shows variations from the contract requirements, the Contractor shall include description of such variations, including notification of cost increase or decrease, in writing at the time of submission.

Contractor shall specifically point out variations from contract requirements in transmittal letters. Failure to obtain Contracting Officer approval for variations, and associated costs, prior to executing work may result in the Government rejecting executed work, and requiring removal and replacement at no additional cost to the Government per FAR 52.236-21.

1.6.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including the Contractor's Designer of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.6.4 Review Schedule Is Modified

In addition to normal submittal review period, the Government will be allowed a period of 30 working days to consider submittals with variations.

1.7 UPDATED SUBMITTAL REGISTER

The Contractor shall prepare and maintain submittal register, as the work progresses. The submittal register must have the following columns, as a minimum:

Specification Section in which submittal is required.

Submittal Description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Principal Paragraph Number, in specification section where a material or product is specified.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.7.1 Use of Submittal Register

Submit Submittal Register with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Activity number from the project schedule.

Scheduled date for approving authority to receive submittals.

Date Contractor needs approval of submittal.

Date that Contractor needs material delivered to Contractor control.

1.8 SCHEDULING

Within 30 calendar days of notice to proceed, provide, for approval by the Contracting Officer, a schedule of all submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal, the material, item, or process for which the submittal is required, the "SD" number and identifying title of the submittal, the Contractor's anticipated submission date and the approval need date.

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay

damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register.

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

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

1.9 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Contracting Officer, the Government will return submittals with review notations as described herein.

1.9.1 Review Notations

Contracting Officer review will be completed within 15 working days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "return for correction" or "not approved," indicate noncompliance with the contract requirements or design concept, or the submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.10 SUBMITTALS NOT APPROVED

The Contractor shall make corrections required by the Contracting Officer. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.11 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals is not be construed as a complete check, and indicates only that:

Approval will not relieve the Contractor of the responsibility for any error which may exist. The Contractor shall fulfill Contractor Quality Control (CQC) requirements of this contract.

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.

1.12 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor shall assure that the materials or equipment will be available in quantities required in the project.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, and any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. The Contractor shall replace such materials or equipment to meet contract requirements at no additional cost to the Government.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

1.13 PROGRESS SCHEDULE

1.13.1 Bar Chart

a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible format and three (3) copies.

b. Submit the progress chart in one reproducible format and three (3) copies to the Contracting Officer for approval no later than 15 days after Notice to Proceed.

c. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

d. Include no less than the following information on the progress chart:

(1) Break out by major headings for each primary work activity.

(2) A line item break-out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization tasks, which include punch list, clean-up, O&M Data, demolition, and As-Built drawings. These activities are to show no associated costs.

(4) The estimated percentage weight of total contract value for each

line item on the chart. This shall be consistent with the Schedule of Values.

(5) Separate line items for submittal preparation and reviews. These shall be consistent with the "Schedule of Submittals" required in Section 01 45 00.10 40, "CONTRACTOR QUALITY CONTROL". These activities are to show no associated costs.

(6) Separate line items for mobilization and demobilization.

e. Update the progress schedule in one reproducible format and three (3) copies every 30 calendar days throughout the contract performance period. The updated schedule shall be submitted with the monthly payment request.

1.14 STATUS REPORT ON MATERIAL ORDERS

Within 30 calendar days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, an initial material status report on all material orders. This report will be updated and re-submitted every 14 calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, material orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or Definable Feature of Work (DFOW) affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
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		01 14 00	SD-01 Preconstruction Submittals															
			Contact List of Key Personnel	1.2.1.2	G													
		01 20 00.00 20	SD-01 Preconstruction Submittals															
			Schedule of Values	1.2	G													
			SD-11 Closeout Submittals															
			Contractor's Invoice	1.3														
		01 30 00	SD-01 Preconstruction Submittals															
			Electronic Mail (E-Mail) Address	1.8	G													
			View location map	1.3	G													
			Progress and completion pictures	1.4	G													
			SD-04 Samples															
			Color boards	1.2	G													
		01 32 01.00 10	SD-01 Preconstruction Submittals															
			Project Schedule	3.3	G													
		01 33 00	SD-01 Preconstruction Submittals															
			Updated Submittal Register	1.7	G													
		01 35 14.11 40	SD-01 Preconstruction Submittals															
			Contractor's Accident Prevention	1.8.1	G													
			Plan															
			Activity Hazard Analysis	1.9.1	G													
			Request for Excavation and	1.17.1	G													
			Digging Permit															
			Request for Confined Space	1.17.2	G													
			Entry Permit															
			Request for Utility Outage/Facility	1.17.3	G													
			Closure Permit															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		01 35 14.11 40	Request for Crane Operation	1.17.4	G													
			Permit															
			Request for Open Flame and	1.17.5	G													
			Hotwork Permit															
			Request for Energized Electrical	1.17.6	G													
			Work Permit;															
			SD-06 Test Reports															
			Gas Protection	1.17.2.1														
			SD-07 Certificates															
			Contractor's Accident Prevention	1.8.1														
			Plan															
			Protection Plan	1.8.2														
			License Certificates	1.20														
			Safety Meeting/Safety Inspection	1.12.2														
			sheets															
			Safety Meeting Attendance	1.12.2														
			sheets															
			SD-08 Manufacturer’s Instructions															
			Safety Data Sheets	1.9.2	G													
		01 35 40.00 20	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.8	G													
			Instructor Qualifications	1.9.1														
			SD-03 Product Data															
			Packaging	2.1.2														
			SD-06 Test Reports															
			Field Quality Control Reports	3.2														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
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		01 35 40.00 20	SD-07 Certificates															
			Environmental Regulatory	1.6														
			Requirements															
			SD-08 Manufacturer's Instructions															
			Safety Data Sheets	1.7.1														
			SD-11 Closeout Submittals															
			Training Program	1.9.3														
			Protection of Natural Resources	3.1														
			Contractor's NPDES/SWPPP	3.1.2														
		01 45 00.10 40	SD-01 Preconstruction Submittals															
			QC Plan	1.6	G													
		01 45 35	SD-07 Certificates															
			Special Inspector	1.5	G													
			Quality Control Plan	1.4	G													
		01 50 00	SD-01 Preconstruction Submittals															
			Construction site plan	1.4	G													
			Traffic control plan	3.3.1	G													
			SD-06 Test Reports															
			Backflow Preventer Tests	1.5.3														
			SD-07 Certificates															
			Backflow Tester	1.5.1														
			Backflow Preventers	1.5														
		01 74 19	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.6	G													
			SD-11 Closeout Submittals															
			Records	1.7														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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		01 74 19	Salvage Material Records	1.8														
		01 75 00.00 40	SD-01 Preconstruction Submittals															
			Verification of Prior Experience	1.2.1	G													
			Documentation of Manufacturer's	1.2.1	G													
			Prior Experience															
			Quality Control Plan	1.2.1	G													
			Manufacturer's Sample Warranty	1.2.1														
			Operation and Maintenance Data	1.2.1	G													
			Operation and Maintenance Data	1.2.3	G													
			Provide Evidence	1.2.1														
			SD-02 Shop Drawings															
			Drawings, Diagrams and	1.2.2	G													
			Schedules															
			Diagrams and Instructions	1.2.2	G													
			Drawings	1.2.2	G													
			SD-03 Product Data															
			Catalog cuts	1.2.3	G													
			Samples of warranty language	1.2.3	G													
			SD-05 Design Data															
			Design Calculations	1.2.3	G													
			SD-06 Test Reports															
			Factory Tests	1.2.4.2	G													
			Functional Field Test	1.2.4.3	G													
			Final Acceptance Test	1.2.4.4	G													
			Test Procedures	1.2.4.5	G													
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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		01 75 00.00 40	Qualification of Manufacturer	1.2.1	G													
			Qualification of Installer	1.2.1														
			SD-08 Manufacturer's Instructions															
			Manufacturer's Administrative	1.2.1	G													
			Requirements															
			Demonstration and Training	1.2.1	G													
			Information															
			Manufacturer's Procedural	1.2.1	G													
			Requirements															
			SD-09 Manufacturer's Field															
			Reports															
			Documentation of the Testing	1.2.4.3	G													
			and Verification Actions															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance Data	1.2.1														
			Operation and Maintenance Data	1.2.3														
			Safety and Security Data or	1.2.3														
			Posters															
		01 78 00	SD-03 Product Data															
			As-Built Record of Equipment	1.3.2														
			and Materials															
			Warranty Management Plan	1.7.1														
			Warranty Tags	1.7.4														
			Final Cleaning	1.9														
			Spare Parts Data	1.4														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		01 78 00	SD-08 Manufacturer's Instructions															
			Preventive Maintenance	1.5														
			Condition Monitoring (Predictive	1.5														
			Testing)															
			Inspection	1.5														
			Instructions to be Posted	1.7.1														
			SD-10 Operation and Maintenance															
			Data															
			Equipment-in-Place List	1.3.5														
			Operation and Maintenance	1.8														
			Manuals															
			SD-11 Closeout Submittals															
			As-Built Drawings	1.3.1														
			Certification of EPA Designated	1.6	G													
			Items															
			NASA Form NF1046	1.10														
		01 86 12.07 40	SD-01 Preconstruction Submittals															
			Quality Control Plan	1.5	G													
			Material, Equipment, and Fixture	2.1	G													
			Lists															
			SD-02 Shop Drawings															
			Connection Diagrams	3.1	G													
			Bearing Layout	2.1.1	G													
			Fabrication Drawings	2.1.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 86 12.07 40	Manufacturer's Catalog Data	2.1.1	G													
			Equipment Foundation Data	2.1.1	G													
			Specific Equipment Data	2.1.3	G													
			Spare Parts List	2.1.4	G													
			Warranty	1.6	G													
			SD-05 Design Data															
			Design Analysis and Calculations	1.4	G													
			SD-06 Test Reports															
			Ductwork Leakage Test	3.3.1	G													
			Operational Fire Damper Test	3.3.1	G													
			Visual Inspection	3.2	G													
			SD-07 Certificates															
			Certificates	2.1.2	G													
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	3.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Operations and Maintenance	3.4	G													
			Manuals															
			SD-11 Closeout Submittals															
			Record Drawings	3.1	G													
			Acceptance Documentation	3.5	G													
		01 86 26.07 40	SD-01 Preconstruction Submittals															
			Quality Control Plan	1.5	G													
			Material, Equipment, and Fixture	2.1	G													
			Lists															

SUBMITTAL REGISTER

CONTRACT NO.

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FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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							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	DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 86 26.07 40	SD-02 Shop Drawings															
			Connection Diagrams	3.1	G													
			Fabrication Drawings	2.1.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Manufacturer's Catalog Data	2.1.1	G													
			Equipment Foundation Data	2.1.1	G													
			Specific Equipment Data	2.1.3	G													
			Spare Parts List	2.1.4	G													
			Warranty	1.6	G													
			SD-05 Design Data															
			Design Analysis and Calculations	1.4	G													
			SD-06 Test Reports															
			Visual Inspection	3.2	G													
			SD-07 Certificates															
			Certificates	2.1.2	G													
			SD-08 Manufacturer's Instructions															
			Manufacturer's Instructions	3.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Operations and Maintenance	3.4	G													
			Manuals															
			SD-11 Closeout Submittals															
			Acceptance Documentation	3.5	G													
			Record Drawings	3.1	G													
			Baseline Data Report	3.3.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02 41 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.11	G													
			SD-07 Certificates															
			Demolition Plan	1.2.1	G													
			Notification	1.7	G													
			SD-11 Closeout Submittals															
			Receipts	3.3.3														
		02 83 13.00 20	SD-01 Preconstruction Submittals															
			Occupational and Environmental	1.5.2.3	G													
			Assessment Data Report															
			Lead Compliance Plan	1.5.2.2	G													
			Competent Person	1.5.1.1	G													
			Training Certification	1.5.1.2	G													
			lead waste management plan	1.5.2.8	G													
			written evidence	3.5.2.1	G													
			Medical Examinations	1.5.2.4	G													
			SD-06 Test Reports															
			sampling results	1.5.2.3	G													
			Occupational and Environmental	1.5.2.3	G													
			Assessment Data Report															
			SD-07 Certificates															
			Testing laboratory	1.5.1.3	G													
			Occupant Notification	3.1.1.1	G													
			Third party consultant	1.5.1.4	G													
			qualifications															
			Clearance Certification	3.5.1.1	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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		02 83 13.00 20	SD-11 Closeout Submittals															
			hazardous waste manifest	3.5.2.1	G													
			turn-in documents or weight	3.5.2.1	G													
			tickets															
		03 30 53	SD-02 Shop Drawings															
			Installation Drawings	1.6														
			SD-03 Product Data															
			Air-Entraining Admixture	2.1.3.1														
			Accelerating Admixture	2.1.3.2														
			Water-Reducing or Retarding	2.1.3.3														
			Admixture															
			Curing Materials	2.1.11														
			Expansion Joint Filler Strips,	2.1.6														
			Premolded															
			Joint Sealants - Field Molded	2.1.7														
			Sealants															
			Batching and Mixing Equipment	3.1.4.3														
			Conveying and Placing Concrete	3.2														
			Formwork	2.1.8														
			Forms	2.4														
			Ready-Mix Concrete	2.2														
			Mix Design Data	2.2														
			Air-Entraining Admixtures	2.2														
			Fly Ash	2.2														
			Accessories	2.5														
			Curing Compound	2.5.1														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		03 30 53	SD-06 Test Reports															
			Aggregates	2.1.2														
			Concrete Mixture Proportions	1.4.3														
			Compressive Strength Testing	3.10														
			Slump	3.10														
			SD-07 Certificates															
			Cementitious Materials	2.1.1														
			CPG for recycled materials or	1.6.1														
			appropriate Waiver Form															
			Aggregates	2.1.2														
			Bill of Lading	2.2														
		05 50 13	SD-02 Shop Drawings															
			angles and plates	2.3														
		06 10 00	SD-02 Shop Drawings															
			Oriented Strand Board	2.2														
			Adhesives	2.4.6														
			SD-06 Test Reports															
			Preservative-treated	1.4.3														
			SD-07 Certificates															
			Certificates of grade	1.8.1														
			Preservative treatment	1.7														
		07 54 19	SD-02 Shop Drawings															
			Detail Drawings	1.7	G													
			Roof plan	1.7	G													
			SD-03 Product Data															
			PVC Roofing Membrane	3.3.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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		07 54 19	Bonding Adhesive	2.1.2														
			Flashing	1.6.5														
			Flashing	3.3.2.2														
			Membrane Fasteners and Plates	2.1.5														
			Pre-manufactured accessories	2.1.7														
			SD-05 Design Data															
			Wind Uplift Resistance	1.3.2	G													
			SD-07 Certificates															
			Qualification of manufacturer	1.6.1														
			Qualifications of Applicator	1.6.2														
			Qualification of Engineer of	1.6.4														
			Record															
			Wind Uplift Resistance	1.3.2														
			Fire Resistance	1.3.1														
			Minimum Polymer Thickness	2.1.1														
			Minimum Polymer Thickness	2.1.4														
			Sample	1.11	G													
			SD-08 Manufacturer’s Instructions															
			Application Method	3.3	G													
			Membrane Flashing	2.1.4	G													
			Membrane Flashing	3.4.2	G													
			Perimeter Attachment	3.3.4														
			Auxiliary Fasteners	2.1.5.2														
			Pre-manufactured accessories	2.1.7														
			SD-11 Closeout Submittals															
			Warranty	1.11	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
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		07 60 00	SD-02 Shop Drawings															
			Base flashing	3.1.11	G													
			Counterflashing	3.1.12	G													
		07 61 14.00 20	SD-02 Shop Drawings															
			Roofing	1.2.5	G													
			SD-03 Product Data															
			Roofing panels	2.1	G													
			Attachment clips	2.3														
			Closures	2.4.1														
			Accessories	2.4														
			Fasteners	2.4.2														
			Sealants	2.4.3														
			warranty	1.7	G													
			SD-04 Samples															
			panel	2.1														
			Accessories	2.4														
			Sealants	2.4.3														
			Intermediate Support	2.2														
			SD-05 Design Data															
			Design calculations	1.5														
			SD-06 Test Reports															
			Field Inspection	3.6														
			Structural performance	1.3.3														
			Finish	1.6.6														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		07 61 14.00 20	Manufacturer's Technical	1.6.3														
			Representative															
			Installer's Qualifications	1.6.4														
			Coil stock	2.1	G													
			SD-08 Manufacturer’s Instructions															
			Installation	3.3	G													
			SD-11 Closeout Submittals															
			Information card	3.8														
		07 84 00	SD-02 Shop Drawings															
			Firestopping Materials	2.1														
			SD-07 Certificates															
			Manufacturer's Technical	1.4.2														
			Representative															
			Firestopping Materials	2.1														
			Installer Qualifications	1.4.1														
			Inspection	3.3														
		07 92 00	SD-03 Product Data															
			Sealants	2.1														
			Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
			SD-07 Certificates															
			Sealant	3.3.6														
		08 11 13	SD-02 Shop Drawings															
			Doors	2.1	G													
			Doors	2.1	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		08 11 13	Frames	2.7	G													
			Frames	2.7	G													
			Weatherstripping	2.9														
			SD-03 Product Data															
			Doors	2.1	G													
			Frames	2.7	G													
			Weatherstripping	2.9	G													
		08 71 00	SD-02 Shop Drawings															
			Hardware schedule	1.3	G													
			SD-03 Product Data															
			Hardware items	2.3	G													
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G													
			SD-11 Closeout Submittals															
			Key Bitting	1.4														
		09 22 00	SD-02 Shop Drawings															
			Metal support systems	2.1	G													
		09 29 00	SD-03 Product Data															
			Cementitious backer units	2.1.9														
			Glass Mat Water-Resistant	2.1.6														
			Gypsum Tile Backing Board															
			Water-Resistant Gypsum	2.1.5														
			Backing Board															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		09 29 00	Impact Resistant Gypsum Board	2.1.8														
			Accessories	2.1.15														
			SD-07 Certificates															
			Asbestos Free Materials	2.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Waste Management	3.9														
		09 51 00	SD-02 Shop Drawings															
			Approved Detail Drawings	1.2														
			SD-03 Product Data															
			Acoustical Ceiling Systems	1.2.1														
			SD-04 Samples															
			Acoustical Units	2.1														
			Acoustic Ceiling Tiles	2.1.1														
			SD-06 Test Reports															
			Fire Resistive Ceilings	1.2.1														
			Ceiling Attenuation Class and	1.2.2														
			Test															
			SD-07 Certificates															
			Acoustical Units	2.1														
			Acoustic Ceiling Tiles	2.1.1														
		09 90 00	SD-02 Shop Drawings															
			Piping identification	3.7														
			stencil	3.7	G													
			SD-07 Certificates															
			Applicator's qualifications	1.3														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		09 90 00	Qualification Testing	1.4.1.2	G													
			SD-08 Manufacturer’s Instructions															
			Application instructions	3.2.1	G													
			Mixing	3.5.2	G													
			Manufacturer's Material Safety	1.7.2	G													
			Data Sheets															
		10 44 00	SD-01 Preconstruction Submittals															
			Manufacturer's Data	2.1														
			SD-02 Shop Drawings															
			Fire Curtain	1.3.1	G													
			Fire Curtain	2.1	G													
			Accessories	1.3.1	G													
			SD-03 Product Data															
			Fire Curtain	1.3.1	G													
			Fire Curtain	2.1	G													
			Accessories	1.3.1														
			Replacement Parts	3.2.1														
			SD-04 Samples															
			Aircraft cable	1.3.1	G													
			Accessories	1.3.1	G													
			SD-07 Certificates															
			Connection brackets	1.3.1	G													
			Manufacturer's Warranty with	2.1														
			Inspection Tag															
		21 13 00.00 40	SD-01 Preconstruction Submittals															
			Records of Existing Conditions	1.2														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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		21 13 00.00 40	SD-02 Shop Drawings															
			Sprinkler Heads	2.5	G													
			SD-03 Product Data															
			Aboveground Piping Materials	2.2	G													
			Valves	2.6														
			Riser Alarm Equipment	2.4														
			Sprinkler Heads	2.5														
			Miscellaneous Materials	2.7														
			Supporting Elements	2.3														
			Equipment and Performance	2.1														
			Data															
			SD-05 Design Data															
			Design Analysis and Calculations	1.2														
			SD-06 Test Reports															
			Pressure Tests	3.10.3														
			System Operating Tests	3.10														
			Air Tests	3.10														
			Valve-Operating Tests	3.10														
			Drainage Tests	3.10														
		21 13 18.00 10	SD-02 Shop Drawings															
			Shop Drawings	1.4.3	G													
			As-Built Drawings	3.8	G													
			SD-03 Product Data															
			Fire Protection Specialist	1.4.1	G													
			Installer Qualifications	1.4.2														
			List of Submittals	1.4.1														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		21 13 18.00 10	Materials and Equipment	2.1	G													
			Spare Parts	1.6														
			OnSite Training	3.9	G													
			SD-05 Design Data															
			Sway Bracing	3.4.1	G													
			Hydraulic Calculations	1.2.1.2	G													
			SD-06 Test Reports															
			Preliminary Tests	3.7	G													
			Final Acceptance Tests	3.8	G													
			SD-07 Certificates															
			Inspection by Fire Protection	3.3	G													
			Specialist															
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.9	G													
			Instructions															
		21 13 20.00 20	SD-02 Shop Drawings															
			Fire extinguishing system	1.3.1.1	G													
			SD-03 Product Data															
			Pipe, fittings, and mechanical	2.11.1	G													
			couplings															
			Deluge valves	2.1.1	G													
			Valves	2.11.5	G													
			Pipe hangers and supports	2.11.4	G													
			Pressure switch	2.6.2.1	G													
			Alarm bells	2.6.1	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		21 13 20.00 20	Trouble Alarm	2.6.3	G													
			Proportioning equipment	2.8	G													
			Foam concentrate	2.7	G													
			Strainers	2.11.3	G													
			Manual release stations	2.2	G													
			Abort stations	2.3	G													
			SD-05 Design Data															
			Hydraulic calculations	1.3.1.2	G													
			Pressure discharge graphs or	1.3.1.2	G													
			tables															
			SD-06 Test Reports															
			Preliminary tests	3.8.6	G													
			Acceptance tests	3.8.3	G													
			diaphragm pressure	2.8.1	G													
			proportioning tanks															
			SD-07 Certificates															
			Qualifications of installer	1.5.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Deluge valves	2.1.1	G													
			Proportioning equipment	2.8	G													
			Concentrate storage tanks	3.8.18	G													
			fire extinguishing system	1.3.1.1	G													
			SD-11 Closeout Submittals															
			As-built drawings for the fire	1.3.1.3	G													
			extinguishing system															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		21 13 24.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.4.3	G													
			As-built Drawings	1.4.1														
			SD-03 Product Data															
			Materials and Equipment	2.1	G													
			Spare Parts	1.5														
			AFFF System	1.2	G													
			Installer's Qualifications	1.4.2	G													
			Post-discharge Test	3.5.3	G													
			Requirements															
			SD-06 Test Reports															
			Test Reports	3.5.3	G													
			SD-07 Certificates															
			Materials and Equipment	2.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.7	G													
			Manuals															
		21 30 00	SD-02 Shop Drawings															
			Installation Drawings	1.2	G													
			As-Built Drawings	3.9.5	G													
			Piping Layout	1.2	G													
			Pump Room	1.2	G													
			SD-03 Product Data															
			Fire Pump Installation Related	3.2														
			Submittals															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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		21 30 00	Catalog Data	2.1	G													
			Spare Parts	1.7														
			Preliminary Tests	3.9.2														
			Field Tests	3.9	G													
			Fire Protection Specialist	1.4.1	G													
			Manufacturer's Representative	1.4.5	G													
			Field Training	3.11	G													
			SD-06 Test Reports															
			Preliminary Tests	3.9.2														
			Final Acceptance Test	3.9.3														
			SD-07 Certificates															
			Fire Protection Specialist	1.4.1	G													
			Qualifications of Welders	1.4.2														
			Qualifications of Installer	1.4.3														
			Preliminary Test Certification	1.4.4														
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.11														
			Instructions															
			Flow Meter	2.1														
		23 31 13.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	Part 2	G													
			Lists															
			Records of Existing Conditions	2.1.1	G													
			SD-02 Shop Drawings															
			Connection Diagrams	2.1	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		23 31 13.00 40	Record Drawings	1.3	G													
			Offset Fitting Configurations	2.3.1	G													
			SD-03 Product Data															
			Equipment and Performance	2.1.1	G													
			Data															
			Galvanized Steel Ductwork	2.2.1	G													
			Materials															
			Brazing Materials	2.2.2	G													
			Mill-Rolled Reinforcing and	2.2.3	G													
			Supporting Materials															
			Round Sheet Metal Duct Fittings	2.3.1	G													
			Turning Vanes	2.3.2	G													
			Flexible Connectors	2.3.3	G													
			Flexible Duct Materials	2.3.6	G													
			Gravity Backdraft and Relief	2.3.7	G													
			Dampers															
			SD-05 Design Data															
			Design Analysis and Calculations	2.1	G													
			Design Analysis and Calculations	2.1.1	G													
			SD-07 Certificates															
			Listing of Product Installations	3.2	G													
			Galvanized Steel Ductwork	2.2.1	G													
			Materials															
			Brazing Materials	2.2.2	G													
			Mill-Rolled Reinforcing and	2.2.3	G													
			Supporting Materials															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		23 31 13.00 40	Round Sheet Metal Duct Fittings	2.3.1	G													
			Turning Vanes	2.3.2	G													
			Flexible Connectors	2.3.3	G													
			Operation and Maintenance	3.5	G													
			Manuals															
		23 37 13.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	2.1	G													
			Lists															
			Records of Existing Conditions	2.1	G													
			SD-02 Shop Drawings															
			Fabrication Drawings	2.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Equipment and Performance	1.2	G													
			Data															
			SD-04 Samples															
			Manufacturer's Standard Color	2.1	G													
			Chart															
		26 05 00.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment,	1.6														
			Conduits, Raceways and Fittings	3.1														
			Wire and Cable	2.2														
			Splices and Connectors	2.3														
			Switches	2.4														
			Receptacles	2.5														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		26 05 00.00 40	Outlets, Outlet Boxes, and Pull	2.6														
			Boxes															
			Circuit Breakers	2.7														
			Pad-mounted, liquid-filled,	2.8														
			medium-voltage Transformers															
			SD-03 Product Data															
			Conduits, Raceways and Fittings	3.1														
			Wire and Cable	2.2														
			Splices and Connectors	2.3														
			Switches	2.4														
			Receptacles	2.5														
			Outlets, Outlet Boxes, and Pull	2.6														
			Boxes															
			Circuit Breakers	2.7														
			Pad-mounted, liquid-filled,	2.8														
			medium-voltage Transformers															
			Spare Parts	1.5														
			Certification	1.6														
			SD-06 Test Reports															
			Continuity Test	3.8														
			Phase-Rotation Tests	3.8														
			Insulation Resistance Test	3.8														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	1.6														
		26 05 13.00 40	SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		26 05 13.00 40	Single-Conductor Shielded	2.4														
			Cables															
			SD-06 Test Reports															
			Dielectric Absorption Tests	3.2														
			High-Voltage Tests	3.2														
			SD-07 Certificates															
			Certificates	1.3														
			Flammability	2.3														
			Minimum Bending Radius	3.1.4														
			High-Voltage Tests	3.2														
			Dielectric Absorption Tests	3.2														
			Cable Splicers	1.6														
			SD-08 Manufacturer’s Instructions															
			Medium-Voltage Power Cables	1.7														
		26 05 19.00 10	SD-03 Product Data															
			Installation Instructions	3.1														
			SD-06 Test Reports															
			Tests, Inspections, and	3.2														
			Verifications															
		26 05 48.00 10	SD-02 Shop Drawings															
			Equipment Requirements	1.3														
			SD-03 Product Data															
			Equipment Requirements	1.3	G													
			Contractor Designed Bracing	1.2.4	G													
		26 05 70.00 40	SD-01 Preconstruction Submittals															
			Fuses	1.3	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		26 05 70.00 40	Sample Warranty	1.3	G													
			SD-02 Shop Drawings															
			Control Devices	1.3	G													
			Protective Devices	3.1	G													
			SD-03 Product Data															
			Enclosures	1.3	G													
			Circuit Breakers	1.3	G													
			Control Devices	1.3	G													
			Protective Relays	1.3	G													
			SD-06 Test Reports															
			Dielectric Tests	3.2	G													
			Timing Test	3.2	G													
			Final Test Reports	3.2	G													
			SD-07 Certificates															
			Circuit Tests	2.7	G													
			Warranty	3.4	G													
			SD-08 Manufacturer's Instructions															
			Control Devices	1.3	G													
			Protective Devices	3.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Circuit Breakers	1.3	G													
			Protective Relays	1.3	G													
			Indicating Instruments	1.3	G													
		26 05 71.00 40	SD-01 Preconstruction Submittals															
			Fuses	2.4														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		26 05 71.00 40	SD-02 Shop Drawings															
			Connection Diagrams	1.3														
			Fabrication Drawings	1.3														
			Control Devices	3.1														
			Protective Devices	3.1														
			SD-03 Product Data															
			Motor Control	2.1														
			Enclosures	2.2														
			Circuit Breakers	2.3														
			Control Devices	3.1														
			SD-07 Certificates															
			Circuit Tests	2.6														
			dielectric tests	3.2														
			SD-08 Manufacturer’s Instructions															
			Control Devices	3.1														
			Protective Devices	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Manual Motor Controllers	2.1.1														
			Magnetic Motor Controllers	2.1.2														
			Combination Motor Controllers	2.1.3														
			Circuit Breakers	2.3														
		26 08 00	SD-06 Test Reports															
			Acceptance tests and inspections	3.1	G													
			SD-07 Certificates															
			Qualifications	1.4.1	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		26 08 00	Acceptance test and inspections	1.4.3	G													
			procedure															
		26 12 19.00 40	SD-02 Shop Drawings															
			Pad-Mounted Transformer	1.5.1	G													
			Drawings															
			SD-03 Product Data															
			Pad-Mounted Transformers	2.2	G													
			SD-06 Test Reports															
			Acceptance Checks And Tests	3.8.1	G													
			SD-07 Certificates															
			Transformer Losses	2.2.3.1	G													
			SD-09 Manufacturer's Field															
			Reports															
			Design Tests	2.7.2	G													
			Routine And Other Tests	2.7.3	G													
			SD-10 Operation and Maintenance															
			Data															
			Transformer(s)	1.6.1	G													
			SD-11 Closeout Submittals															
			Transformer Test Schedule	2.7.1	G													
		26 20 00	SD-02 Shop Drawings															
			Transformers	2.6	G													
			Marking strips	3.1.10.1	G													
			SD-03 Product Data															
			Receptacles	2.4	G													
			Transformers	2.6	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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		26 20 00	Motor controllers	2.8	G													
			SD-06 Test Reports															
			600-volt wiring test	3.5.2	G													
			Grounding system test	3.5.4	G													
			Ground-fault receptacle test	3.5.3	G													
			SD-09 Manufacturer's Field															
			Reports															
			Transformer factory tests	2.15.1														
		26 28 21.00 40	SD-02 Shop Drawings															
			Connection Diagrams	2.1	G													
			Fabrication Drawings	2.1	G													
			Installation Drawings	2.1	G													
			SD-03 Product Data															
			Equipment and Performance	2.1	G													
			Data															
			Contacts	2.3.1	G													
			Indicating Lights	2.3.2	G													
			Terminal Board	2.3.3	G													
			Enclosures	2.2.3	G													
			SD-06 Test Reports															
			Qualification Testing	1.4	G													
			Operation Tests	1.4	G													
			SD-07 Certificates															
			Listing of Product Installations	3.1	G													
			SD-08 Manufacturer's Instructions															
			Automatic Transfer Switch	2.3.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		28 31 64.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.4.2														
			SD-03 Product Data															
			Storage Batteries	2.4														
			Low Battery Voltage	1.2.2														
			Special Tools and Spare Parts	1.7														
			Technical Data and Computer	1.5	G													
			Software															
			Training	3.6														
			Testing	3.7														
			SD-06 Test Reports															
			Testing	3.7														
			SD-07 Certificates															
			Equipment	1.2.6														
			Qualifications	1.4.1														
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.6	G													
			Instructions															
		31 00 00	SD-03 Product Data															
			Utilization of Excavated Materials	3.6	G													
			Shoulder Construction	3.11														
			SD-06 Test Reports															
			Testing	3.13														
			Borrow Site Testing	2.1														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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		31 00 00	Testing	3.13														
		31 32 11	SD-03 Product Data															
			Geotextile Fabrics	2.1														
			Finished Grade	3.1.1														
			Erosion Control Blankets	2.2														
			SD-04 Samples															
			Materials	1.6														
			SD-06 Test Reports															
			Geotextile Fabrics	2.1														
			Erosion Control Blankets	2.2														
		32 31 13	SD-02 Shop Drawings															
			Fence Assembly	1.3	G													
			Location of Gate, Corner, End,	3.17.1	G													
			and Pull Posts															
			Gate Assembly	1.3	G													
			Gate Hardware and Accessories	2.17	G													
			Erection/Installation Drawings	1.3	G													
			SD-03 Product Data															
			Fence Assembly	1.3	G													
			Gate Assembly	1.3	G													
			Gate Hardware and Accessories	2.17	G													
			Zinc Coating	2.2	G													
			Aluminum Alloy Coating	1.5.1	G													
			Stretcher Bars	2.12	G													
			SD-07 Certificates															
			Certificates of Compliance	1.5.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

CONTRACTOR

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		32 31 13	SD-08 Manufacturer's Instructions															
			Fence Assembly	1.3	G													
			Gate Assembly	1.3	G													
			Hardware Assembly	1.3	G													
			Accessories	1.3	G													
		33 40 00	SD-03 Product Data															
			Placing Pipe	3.3														
			SD-04 Samples															
			Pipe for Culverts and Storm	2.1														
			Drains															
			SD-07 Certificates															
			Resin Certification	2.1.5														
			Resin Certification	2.1.6														
			Pipeline Testing	3.8														
			Hydrostatic Test on Watertight	2.7														
			Joints															
			Determination of Density	3.7.5														
			Frame and Cover for Gratings	2.3.7														
		33 70 02.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.3.1	G													
			As-Built Drawings	1.3.2	G													
			SD-03 Product Data															
			Fault Current Analysis	2.15.4	G													
			Protective Device	2.15	G													
			Coordination Study	2.15.5	G													
			Nameplates	2.2	G													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 70 02.00 10	Material and Equipment	2.1	G													
			Installation Requirements	3.2	G													
			SD-06 Test Reports															
			Factory Tests	2.14														
			Field Testing	3.11														
			Operating Tests	3.11.9														
			Cable Installation	3.3.1.4														
			SD-07 Certificates															
			Material and Equipment	2.1														
			Cable Joints	3.4														
		33 71 02.00 20	SD-02 Shop Drawings															
			Precast underground structures	1.4.1	G													
			SD-03 Product Data															
			Medium voltage cable	2.5	G													
			Medium voltage cable joints	2.7	G													
			Medium voltage cable	2.6	G													
			terminations															
			Live end caps	2.8	G													
			Precast concrete structures	2.13.2.1	G													
			Sealing Material	2.13.2.4														
			Pulling-In Irons	3.5.3														
			Manhole frames and covers	2.13.3	G													
			Handhole frames and covers	2.13.4	G													
			Composite/fiberglass handholes	2.13.6	G													
			Cable supports	2.14	G													
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

FY14 CoF Repair Aircraft Hangar Fire Protection Systems

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/	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 71 02.00 20	Arc-proofing test	2.17.1	G													
			Arc-proofing test	2.17.1	G													
			Medium voltage cable	2.17.2	G													
			qualification and production tests															
			Field Acceptance Checks and	3.20.1	G													
			Tests															
			Cable Installation Plan and	3.3														
			Procedure															
			SD-07 Certificates															
			Cable splicer/terminator	1.4.2	G													
			Cable Installer Qualifications	1.4.3														

SECTION 01 35 14.11 40

AFRC SAFETY REQUIREMENTS
07/07

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 NASA's Commitment to Safety

The success of this historic agency starts with an unwavering commitment to safety. The culture of this institution is one of safe accomplishment of our missions, including construction projects. If something about this project, or any task, is unclear, it is required that you, the Contractor, ask for clarification. No activities on this project, or at this Agency, are important enough to compromise the safety of any person. If you suspect something isn't quite right, trust your instincts and your experience, and do something to correct the situation.

NASA's mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.

1.3 The AFRC Safety Culture

Safety at the Armstrong Flight Research Center (AFRC) is of paramount concern. We assure a commitment to safety by employing systems and processes that ensure the safety of the public, the employees, and assets. We ensure safety in all aspects of personal endeavors and we are committed to ensuring the safety of others. We take ownership for safety. We know every accident is preventable. In the spirit of the AFRC Safety Culture, the Contractor shall implement the safety provisions of this section to "make known the overlooked and unexpected" to keep all employees safe. The Contractor shall INSTRUCT ALL EMPLOYEES as to the hazards and the precautions to be taken in performance of this contract. The Contractor shall provide and maintain work environments and procedures which will safeguard Contractor employees, Subcontractors, the Public, Government personnel, and Government property, materials, supplies, and equipment exposed to Contractor operations and activities.

1.4 Construction Safety Goals

The safety provisions of this section are to be implemented by the Contractor so that:

a. Everyone involved in this project goes home as healthy as they arrived.

b. This construction work site is free of recognizable hazards.

c. We have zero lost-time accidents.

d. We have zero injuries in our workplace.

1.5 Construction Safety Strategy

In order to meet these goals every individual working onsite for the Contractor, including Subcontractors, Vendors and their employees, shall:

a. Be involved in making this project safer.

b. Know how to identify hazards.

c. Know how to report hazards and get them fixed.

d. Know their safety and health training needs, have obtained that training, and shall put the concepts to work each and every day while working on this project.

1.6 Compliance

The Contractor shall take safety and health measures in performing work under this Contract. The Contractor shall comply with all applicable federal, NASA/AFRC, Edwards Air Force Base, State and Local occupational safety and health requirements and standards. The Contractor shall take all precautions in the performance of work under this contract to protect the safety and health of the Contractor's employees, to protect the safety and health of all persons in or near the jobsite, and to prevent damage to property, materials, supplies and equipment. The Contractor shall comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. The Contractor shall comply with the U.S. Army Corps of Engineers Safety and Health Requirements Manual in effect on the date of the solicitation.

1.7 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.

ASTM INTERNATIONAL (ASTM)

ASTM F2412	(2011) Standard Test Methods for Foot Protection
ASTM F2413	(2011) Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z89.1	(2009) American National Standard for Requirements for Industrial Head Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2014) National Electrical Code
NFPA 407	(2012; TIA 11-1) Standard for Aircraft Fuel Servicing

NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars
NFPA 410	(2009) Standard on Aircraft Maintenance
NFPA 70E	(2012; Errata 2012) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

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

10 CFR 20	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.501	Duty to Have Fall Protection

1.8 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

The following items shall be submitted in accordance with Paragraphs 1.8.1 "Contractor's Accident Prevention Plan" and 1.9.1 "Activity Hazard Analysis" of this section. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section).

Contractor's Accident Prevention Plan; G
Activity Hazard Analysis; G

The following Requests for Permit shall be submitted ain accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS" of this section.

Request for Excavation and Digging Permit; G
Request for Confined Space Entry Permit; G
Request for Utility Outage/Facility Closure Permit; G
Request for Crane Operation Permit; G
Request for Open Flame and Hotwork Permit; G
Request for Energized Electrical Work Permit; G

SD-06 Test Reports

Records shall be submitted in accordance with paragraph entitled, " Gas Protection," of this section.

SD-07 Certificates

Statements shall be submitted for the following items in accordance with paragraphs entitled, "Contractor's Accident Prevention Plan" and "Protection Plan," of this section.

Contractor's Accident Prevention Plan

Protection Plan

License Certificates

The following shall be submitted with the Contractor's "Daily Report to the Inspector" by 10:00 am the next work day in accordance with Paragraph 1.12.2 "Daily Safety Meetings/Daily Safety Inspections" of this section:

Safety Meeting/Safety Inspection sheets

Safety Meeting Attendance sheets

Confined Space Entry Training Certificates shall be submitted for all Confined Space Entry Attendants/Entry Supervisors prior to any employees entering a confined space. (See also Paragraph 1.10.1 "Documents at the Jobsite" of this section.

SD-08 Manufacturer's Instructions

Safety Data Sheets(SDS), G

SDSs for all chemicals and hazardous materials brought to the jobsite. SDSs shall be submitted in accordance with Paragraph titled "Safety Data Sheets (SDS)" and Paragraph Titled "Chemicals and Hazardous Materials" of this section. (See also Paragraph Titled "Documents at the Jobsite" of this section.)

1.8.1 Contractor's Accident Prevention Plan

Contractor shall submit an Accident Prevention Plan to the Contracting Officer for approval within 14 calendar days after notice to proceed and prior to start of construction at project site. The Accident Prevention Plan written by the prime Contractor for the specific work and hazards of this contract shall implement in detail the pertinent requirements of the US Army Corps of Engineers Safety and Health Requirements Manual. The plan shall define how the Contractor will comply with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926. Prior to initiation of work at the job site, the Contractor's Accident Prevention Plan shall be reviewed, found acceptable, and approved by the Contracting Officer.

Accident Prevention Plan shall be NASA/AFRC site specific and include, as a minimum, the following:

a. Safety program objectives.

b. Methods to attain safety objectives.

c. Responsibility of key personnel for the Contractor.

d. Safety meetings, surveys, inspections, and reports.

e. Disaster and emergency programs as it applies to the NASA/AFRC site.

f. Lists of key personnel to be contacted in times of emergency, along with appropriate phone numbers to be used in emergencies.

g. Program to show compliance with Federal OSHA Safety and Health Standards 29 CFR 1910 and 29 CFR 1926.

h. Methods to comply with the requirement for immediate reporting of mishaps to the Contracting Officer.

i. Statement that the Contractor will not invalidate the integrity of safety systems without proper authorization.

j. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of accident or an act of nature. This shall include procedures to secure dangerous conditions, protect personnel, and secure work areas. The plan must contain 911 telephone contact procedures specific to NASA/AFRC (See Paragraph "FIRST AID AND EMERGENCIES" of this section).

k. Procedures for securing the mishap site so that the area remains secure until arrival of a safety investigator. Mishap site will remain secured until released by the Contracting Officer.

l. A map with the location and times of operation of the NASA/AFRC medical dispensary. (This information can be obtained from the Contracting Officer.)

m. Procedures describing how chemicals, hazardous materials and hazardous wastes will be handled, managed and disposed of while at NASA/AFRC.

n. Incorporate plans for the following, as applicable: Lockout/Tagout, Confined Space, Fire Prevention, Electrical Safety, and Fall Prevention/Protection.

o. Incorporate a comprehensive site-specific heat stress monitoring plan. Drinking water shall be made available to workers and workers shall be encouraged to frequently drink small amounts; the water shall be kept reasonably cool.

1.8.2 Protection Plan

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage.

1.9 GENERAL SAFETY PROVISIONS

Contractor shall take safety and health measures in performing work under this Contract. Contractor shall meet with the Contracting Officer to develop a mutual understanding relative to administration of the Accident Prevention Plan. Contractor is subject to applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health in effect on the date of this Contract per NASA FAR Supplement 1852.223-70 Safety and Health.

During the performance of work under this Contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site. Contractor is responsible for his personnel and for familiarizing each of his subcontractors with safety requirements. Contractor shall advise the Contracting Officer of any special safety restriction he has established so that Government personnel can be notified of these restrictions.

1.9.1 Activity Hazard Analysis

Prior to beginning each Definable Feature of Work (DFOW), an activity hazard analysis shall be prepared by the Contractor performing the work. A DFOW is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. Work will not proceed on that phase until the activity hazard analysis has been accepted by the Contracting Officer and discussed with all engaged in the activity, including the Contractor, subcontractors, and government on-site representatives.

The Activity Hazard Analysis shall:

a. define the activity to be performed and identify the sequence of work,

b. define the specific hazards anticipated with the activity,

c. define the control measures to be implemented to eliminate or reduce each hazard to an acceptable level,

d. identify the equipment to be used,

e. identify the inspection requirements for that equipment and activity, and

f. list the training requirements for the workers.

1.9.2 Safety Data Sheets (SDS)

Provide the Contracting Officer with a copy of the Safety Data Sheets (formerly Material Safety Data Sheets) for all chemicals and hazardous materials to be brought on site. All manufacturers' recommended precautions shall be followed during the use of any chemical and hazardous material. SDSs must be submitted to the Contracting Officer for approval prior to the use of any chemical or hazardous substance. See also Paragraph 1.10.1 "Documents at the Jobsite" and Paragraph 1.27.1 "Chemicals and Hazardous Materials" of this section.

1.10 SAFETY COMMUNICATIONS

Accident Prevention Plans, hazard analyses, and SDSs are only effective when the workers in the field are aware of the potential hazards for that day, and take mitigation measures to work safely in that area at that time. Therefore, daily safety communications are a critical requirement. Every work day shall begin with a brief safety meeting and every work day shall include a safety inspection by the Contractor's Site Safety Officer, see Paragraph Titled "Daily Safety Meetings/Daily Safety Inspections".

Also, prior to beginning any new DFOW the Contractor shall conduct an Activity Hazard Analysis on that new class of work and shall conduct a

thorough discussion of that Activity Hazard Analysis with the workers performing the work. The Contractor shall ensure the workers understand the hazards and how to use any special tools, unique equipment, and personal protective equipment. Only after these safety analyses and communications occur shall the new class of work be allowed to proceed.

1.10.1 Documents at the Jobsite

To help maximize safety communications, the following list of documents shall be maintained on the jobsite and made easily available for the Contractor's employees and Subcontractors' employees. These records shall also be made available for Government inspection. They include but are not limited to:

a. the approved Accident Prevention Plan,

b. all approved Activity Hazard Analysis,

c. all approved SDSs,

d. all approved permit documents for Permit Required Operations that have been completed,

e. all records of lockout/tagout operations that have been completed,

f. the jobsite OSHA 300 log,

g. all training records, including Confined Space Entry Training Certificates, and

h. other records that are deemed appropriate due to the nature of the work, i.e. certificates, permits, licenses, etc.

These records shall be stored at a convenient centralized location on the jobsite. These records shall be organized, filed, and labeled in binders or file folders in a fashion that all persons involved with the project can obtain the information quickly and easily.

1.10.2 Posted Warnings and Prohibitions

The Contractor shall comply with procedures prescribed for control and safety of all persons visiting the project site. The contractor shall install all barricades and signs needed. All points of entry to the project site shall have signage warning of the inherent dangers of the work site, and reminding of the requirement to wear hard hats; also signage at specific locations throughout the work site denoting required personal protective equipment associated with the hazard(s) present. The Contractor is responsible for familiarizing each employee and each subcontractor employee with safety requirements.

All Contractor personnel are to obey all posted prohibitions, restrictions, warnings, and traffic control signs and devices. Contractor personnel shall not enter any area in which a red light is flashing without permission of the NASA area supervisor. When alarm bells are sounded in a building, secure the equipment in use and leave the building by the nearest exit. An egress passage must be maintained at all times in the work area. The Contractor shall advise employees of these requirements.

The Contractor shall advise the Contracting Officer of any special safety restrictions the Contractor has established so that Government personnel can be notified of these restrictions.

1.10.3 Display of Safety Information

The Contractor shall erect a safety bulletin board at the job site within 2 calendar days after the Contracting Officer has approved the Accident Prevention Plan. The following information shall be displayed on the safety bulletin board in clear view of the on-site construction personnel, maintained current, and protected against the elements and unauthorized removal:

a. Map denoting the route to the nearest emergency care facility.

b. Emergency phone numbers.

c. Copy of the most up-to-date Accident Prevention Plan.

d. Current AHA(s) and SDSs.

e. OSHA 300A Form.

f. OSHA Safety and Health Protection-On-The-Job Poster.

g. Safety and Health Warning Posters.

h. Active Permits.

1. Excavation and Digging,

2. Confined Space Entry,

3. Utility Outages/Facility Closures,

4. Crane Operations,

5. Open Flame and Hot Work, and

6. Energized Electrical Work.

i. Contractor is encouraged to post in a common area the number of years without a lost time construction accident at NASA's Armstrong Flight Research Center.

1.10.4 TRAINING

1.10.4.1 New Employee Indoctrination

New employees (prime, subcontractor, vendors, and suppliers) onsite will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.10.4.2 Periodic Training

Provide Safety and Health Training in accordance with USACE EM 385-1-1 and the approved Accident Prevention Plan. Ensure all required training has been accomplished for all onsite employees.

1.10.4.3 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new phase, training will be provided to all affected employees to include a review of the AHA to be implemented.

1.11 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contractor shall ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.147. Specific Lockout/Tagout requirements are as follows:

a. The tags shall be the same for both lockout and tagout, and shall only be used once. The information on the tag shall be printed legibly.

b. For lockout the information shall include - name of person controlling the lock, the date the lock was put in place, telephone number of the person controlling the lock, name of the Project Inspector monitoring the work, name of the company serving as prime contractor for the work, and the name of the company for which the lock control person is employed.

c. For tagout, the above information is required plus an explanation of why a lock could not be used, and what additional safety precautions were used to provide the same amount of safety as a lockout.

The above information shall be documented, and the record made available for inspection. Upon completion of the Lockout/Tagout Operation the documents shall be stored at the jobsite.

Contracting Officer will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.

No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, or project leader, has entered into the record such activity.

Only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any mechanical equipment, the apparatus, valves, and/or systems shall be secured in a non-stored energy condition with the appropriate venting, pins, blocking and locks applied.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

1.11.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the paragraph "SAFETY LOCKOUT/TAGOUT PROCEDURES" in this section, and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall require all employees participating in the group lockout/tagout scenario to have individual lockout/tagout locks and tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

1.11.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall notify the Government of completion of the task. That group's or individual's lockout/tagout tags on equipment may only be removed on authorization by the Government after ensuring the safety of those affected.

1.12 SAFETY MEETINGS AND INSPECTIONS

1.12.1 Mutual Understanding Meeting

Before commencing the work, the Contractor shall meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program. Items to be discussed shall include: USACE EM 385-1-1, hard hats/safety shoes, other personal protective equipment (PPE), daily safety meetings, activity hazard analysis, frequency of inspections, 911 communications, stopping of unsafe activities, permit required operations and SDSs.

1.12.2 Daily Safety Meetings/Daily Safety Inspections

The Contractor shall conduct daily safety meetings at the beginning of each work shift. This safety meeting shall be administered by the Contractor's Site Safety Officer and/or Job Superintendent, or qualified designated representatives of these elements. This safety meeting shall be attended by all of the Contractor's employees, as well as all subcontractors and their employees working at the project site for that day. If any of these persons are not present at the daily safety meeting, they shall be briefed of the issues discussed in the meeting on an individual basis by the Contractor's Site Safety Officer prior to starting work at the site that day. The safety meeting format and discussion shall include, but not be

limited to: the schedule of events on the site for the day; addressing hazard analyses for the day's activities; allowing employees and subcontractors to submit hazard analyses and SDSs for upcoming activities; planning permit required operations; discussing unsafe conditions and near misses on the job site; discussing new equipment and material deliveries to the job site; discussing corrective actions to be taken and assignment of responsibilities for the implementation of those corrective actions.

The Contractor's designated Site Safety Officer shall, at least once per shift, conduct at least one walk-through site safety inspection of all site activities. This inspection shall be conducted at a random time during each shift. The Site Safety Officer's sole purpose during the walk-through shall be to ensure compliance with the approved Accident Prevention Plan, approved Activity Hazard Analysis, and approved SDSs. Additionally the Site Safety Officer must ensure the workers receive feedback as to their safety effectiveness and compliance with safety procedures.

The Contractor shall use the attached Safety Meeting/Safety Inspection sheets and Safety Meeting Attendance sheets, or an approved equal, to report the elements described herein. These sheets shall be submitted to the Contracting Officer on a daily basis by 10:00 am on the next work day, (with the Contractor's "Daily Report to the Inspector").

1.13 CONTRACTOR VEHICLES AND EQUIPMENT

Edwards AFB access passes for Contractor owned vehicles are included in the personnel pass and/or badging process. Proof of registration and insurance, as well as a valid driver's license, must be presented at that time.

Contractor-owned, leased, or operated equipment must be in satisfactory mechanical condition. Identification is required on both sides of all contractor vehicles and equipment, clearly identifying the contractor. While in use at the job site, rental equipment shall be kept in good working order and properly maintained. Contractor equipment, whether rented or owned, which is subject to air permit requirements must be accompanied by a copy of the air permit while on site.

Prior to a piece of rental equipment arriving on the job site, the Contractor shall present a hazard analysis for the use of the equipment. The hazard analysis shall include consideration for hazards associated with unloading, moving, and reloading the equipment. The Contractor is responsible to ensure that all employees working on or around that equipment are properly trained to use it and made aware of its associated hazards.

Hoisting and lifting devices and cranes must bear evidence of periodic inspection and dynamic load testing within the preceding 12 months and live load testing within the preceding 48 months; additionally, any more stringent ANSI and OSHA requirements for the equipment type still apply. Operators of hoisting and lifting devices and cranes shall be trained in proper use and safety limitations. The Contractor shall provide written proof of qualification for all operators of fork lifts and personnel lifts (i.e. boom lifts, platform lifts, scissors lifts, etc.). Outdoor hoisting operations shall not commence if winds are above 20 knots (23 mph) steady state or if gusts exceed 35 knots (40 mph) and the Contractor shall also comply with the manufacturer's recommended operating limits; the more restrictive shall govern.

Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16

and Appendix G. In addition, for mobile cranes, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Written proof of current qualification shall be provided.

Contractor owned vehicles which will be driven on the flight line (aircraft hangars, aprons, ramps, tow-ways, and taxiways) must bear identifying signs and property damage insurance. Access to the flight line must be authorized by the Contracting Officer. The Contractor shall be responsible for performing daily inspections of these vehicles and shall secure, remove, or dispose of all foreign objects, materials, and debris that can cause damage to an aircraft. Objects and debris lodged between tire treads shall be removed prior to driving on the flight line. All vehicles authorized by the Contracting Officer to be on aircraft maintenance ramps, fuel storage areas, and fuel servicing areas, shall comply with NFPA 407, Standards for Aircraft Fuel Servicing. All vehicles authorized by the Contracting Officer to be in aircraft hangars shall comply with NFPA 70, National Electrical Code; NFPA 410, Standard on Aircraft Maintenance; and NFPA 409, Standard on Aircraft Hangars.

Operators of motor vehicles shall be licensed. Only Contractor work vehicles, delivery vehicles, and debris hauling vehicles, driven by licensed operators, will be allowed at the work site. Vehicles for transportation of personnel or personal tools (commuting) must be parked in designated parking spaces.

The use of seat belts is mandatory by all operators and passengers traveling in motor vehicles on Edwards Air Force Base and NASA AFRC. Passengers are prohibited from riding in or on the back or bed of any truck. The speed limit, unless otherwise posted, is 15 miles per hour. The security police use radar units.

Use of Government owned equipment, tools, supplies, or materials is prohibited unless specifically authorized by the Contracting Officer.

1.13.1 VEHICLE FOREIGN OBJECT DEBRIS (FOD) PREVENTION STEPS

Cars, trucks, trailers, and mobile service vehicles that have access to aircraft operational areas are a potential source of FOD (also known as Foreign Object Damage/Debris). Prevention that should be taken includes:

a. Regularly inspect all vehicles such as refueling trucks, supply trucks, contract vehicles, and maintenance vehicles that operate on the flight line and hangar areas for foreign objects.

b. Before a vehicle is driven onto taxiways, runways, or into aircraft parking areas, the driver will stop and check that there are no rocks or pebbles caught in the tire treads and that the load is secure. The driver will also check the vehicle for loose items and secure all loose tools, hardware, trash, and other potential debris (near open windows, on exposed shelving, in pickup beds, unlocked cabinets, etc.).

c. Vehicles must not be driven off the hard surface unless absolutely necessary. If it does become necessary to drive off to let an aircraft pass or for any other reason, the driver will once again check the load for security and the tires for foreign objects before re-entering the hard surfaced area. This does not apply to emergency vehicles responding to an emergency.

d. All vehicles will enter and leave the flight line at controlled access points unless an emergency vehicle is responding to an emergency.

1.14 ACCIDENT TREATMENT AND RECORDS

Contractor shall post emergency first aid and ambulance information at project site.

1.15 FIRE PREVENTION AND PROTECTION

Open-flame, and spark-producing heating devices will not be permitted except with an Open Flame and Hot Work permit approved per paragraph "PERMIT REQUIRED OPERATIONS" in this section. Approval for the use of open fires and open-flame or spark-producing heating devices will not relieve the Contractor from the responsibility for any damage incurred because of fires.

Burning trash, brush, or wood on the project site shall not be permitted.

Any fire hazard conditions shall be immediately reported to Contracting Officer. Any fire emergency situation shall be reported by calling 911 or the NASA/AFRC Security Post #1 at (661) 276-3256. Contractor vehicles must not block or encroach upon fire truck lanes at any time. The Contractor shall provide temporary fire protection equipment for the protection of personnel and property during construction.

All work sites shall be kept clean and orderly at all times. Combustible scrap, debris, and waste materials (oily rags, paper, packaging, scrap wood, etc.) shall be stored in covered metal receptacles and removed from the worksite daily to minimize potential hazards. Flammable and combustible materials shall be stored in a manner which minimizes the risk of fire including spontaneous combustion. "No Smoking" signs shall be posted in areas where flammable or combustible material are stored.

Only UL-approved containers and tanks shall be used for storage and handling of flammable and combustible liquid. All flammable and combustible liquids shall be kept in closed containers when not in use. Bulk drums of flammable or combustible liquids shall be grounded and bonded to containers during dispensing. The Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher placed within 20 feet where flammable/combustible liquids are stored.

The Contractor shall ensure the following are complied with when pressurized cylinders are on the jobsite:

a. Cylinder contents shall be identified with a label.

b. All cylinders shall be stored in an upright position at all times.

c. Cylinders shall be secured at all times.

d. Cylinders not in use shall have valve protector caps in place.

Smoking is not permitted in buildings or on roofs. Smoking is permitted in approved designated areas only. Smoking materials shall be disposed in an approved receptacle.

Nonspark producing tools and equipment or pneumatic type shall be utilized in fire hazardous areas such as hangars and other explosive environment areas. Burning of trash or rubbish is prohibited.

Dispensing of flammable and combustible liquids is not permitted in buildings or on roofs.

1.16 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without written approval of the Contracting Officer. Explosive-actuated (or powder-actuated) fastening tools are not subject to this constraint if designed, inspected and operated per EM 385-1-1.

1.17 PERMIT REQUIRED OPERATIONS

The Contractor shall coordinate with the Contracting Officer and obtain written approval from the Contracting Officer on all Permit Required Operations before the operation begins. The Contractor shall initiate coordination with the Contracting Officer by writing and submitting a Request for Permit. The Contractor shall provide, with the Request for Permit the following:

a. Work Plan - A written work plan describing the work to be accomplished during the Permit Required Operation including a schedule to be followed. The schedule shall include the dates and time period the Contractor contemplates performing the operation.

b. Activity Hazard Analysis - An activity hazard analysis of the proposed activities during the Permit Required Operation including the Contractor's plan to minimize or eliminate any hazards associated with the performance of the work. See paragraph 1.9.1

The permits are primarily used to identify potentially hazardous work conditions in an attempt to prevent accidents. The permits are also used to coordinate the required work with key AFRC activities and keep customer inconvenience to a minimum. The permits shall be processed just prior to the start of the operation. Permit forms will be provided and filled out by the Government. The Contractor shall post approved permits at a conspicuous location in the construction area near the permitted operation. Upon completion of the Permit Required Operation a copy of the approved permit documents shall be stored at the jobsite in accordance with Paragraph "Documents at the Jobsite" of this section. Permit required operations are:

1. Excavation and Digging,

2. Confined Space Entry,

3. Utility Outages/Facility Closures,

4. Crane Operations,

5. Open Flame and Hot Work, and

6. Energized Electrical Work.

1.17.1 Excavation and Digging

Surface penetration, excavation, digging, and trenching are Permit Required Operations. Surface penetration, excavation, digging, and trenching operations must be approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Excavation and Digging Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer seven (7) calendar days prior to the start of digging operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities.

The permit, a NASA - AFRC EXCAVATION AND DIGGING PERMIT (Form D-WK 808-8), must be filled out by the Government and attached to the Contractor's Request for Excavation and Digging Permit. This package must be reviewed and approved by several AFRC and USAF organizations prior to start of surface penetration, excavation, digging, or trenching. During this review and approval period the Contractor can proceed with marking and staking activities described below.

Prior to performing any surface penetrations, excavation, digging, or trenching 6 inches or deeper (including driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain from the Contracting Officer the current subsurface utility drawing of the particular area to be worked on. All utility lines shall be identified and marked in the field. The Contractor shall stake out, mark, paint lines, or other wise identify all subsurface pressurized gas pipes, high voltage cables, communication cables, other pipe lines, and other subsurface structures indicated within the area of the work before any surface penetration, excavation, digging, or trenching is done. After identification is complete, the Contractor shall obtain agreement from the Contracting Officer that identification is sufficient. After obtaining the approved permit package from the Contracting Officer and completing the marking and staking activities, the Contractor shall proceed with the excavating and digging operation in accordance with the approved permit documents.

The Contractor, however, shall temporarily halt any powered equipment digging and machine excavation work (i.e. backhoe, jackhammer, trencher, auger, etc.) when approaching within 10 feet of the staked-out/marked utility until the Contractor has exposed the utility by hand excavation to fix its location. The utility must be exposed carefully (i.e. "pot holing") using hand digging methods or with a hydro-vacuum excavator or alternative approved by the Contracting Officer. The Contractor shall obtain agreement from the Contracting Officer on how much closer to the utility the machine excavations can be allowed. Powered equipment digging shall not be performed within 5 feet of any utility. All powered equipment must be positioned so that it cannot come any closer than 5 feet from the utility. Backhoes must be positioned so that when the arm is in the full extension it cannot come any closer than 5 feet to the utility and the arm must always be drawn away from the utility thus pulling material toward the operator and away from the utility.

1.17.2 CONFINED SPACE

Comply with the requirements in 29 CFR 1910.146. Any potential for a hazard in the confined space requires a permit system to be used. Comply with the requirements in 29 CFR 1910.146.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Local Authority for entry procedures prior to entering confined space).

   All hazards pertaining to the space shall be reviewed with each employee before entry.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained.

c. Ensure the use of rescue and retrieval devices in confined spaces greater than 5 feet in depth.

d. Sewer waste walls require continuous atmosphere monitoring with audible alarm for toxic gas detection.

e. Include training information for employees who will be involved as entrant attendants for the work.

f. Entry Permit. Use forms D-WK 223-8 "Confined Space Entry Permit", D-WK 224-8 "Non-Permit Confined Space Checklist", and/or D-WK 225-8 "Confined Space Evaluation" or other form with the same minimum information for the Confined Space Entry Permit, completed by the qualified person. Post the permit in a conspicuous place close to the confined space entrance.

Entering a confined space is a Permit Required Operation. Entering a manhole, underground vault, sewage pit, vessel, tank, subfloor area, or other confined space is a permit required operation. Safety clearance from the Contracting Officer is required before any Contractor personnel enter a manhole or vault or any other confined space. Entry must be assessed under Confined Space guidelines. Permit Required Confined Space regulations shall be followed during all confined space entries. Confined space operations must be approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Confined Space Entry Permit in accordance with Paragraph 1.8 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer three (3) calendar days prior to the start of these operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees.

The permit, a CONFINED SPACE ENTRY PERMIT (forms D-WK 223-8, D-WK 224-8, and/or D-WK 225-8), must be filled out by the Government and attached to the Contractor's Request for Confined Space Entry Permit. This package must be reviewed and approved by the Armstrong Safety Office and approved by the Contracting Officer prior to entry. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the confined space operation in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

1.17.2.1 Confined Space - Gas Protection

All work within manholes and other confined spaces shall be considered permit required confined space entry work, unless otherwise designated by the Contracting Officer. Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes and vaults. The Contractor shall have one or more confined space entry attendants/entry supervisors who are properly trained in the operation of gas monitoring equipment and formally qualified as confined space entry attendants/entry supervisors who shall be on duty during times workmen are in confined spaces. Their primary functions shall be to monitor the confined space and operate testing and alarm equipment. Gas monitoring shall be performed prior to entry and continuously when anyone is in the confined space. Readings shall be permanently recorded daily, indicating the concentration of gas, location/point of test and time the space was monitored.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A breathing hazard check by the Government is required prior to entering areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. Surveillance and monitoring shall be required in these types of workspaces by both Contractor and Government personnel.

1.17.3 Utility Outages/Facility Closures

Turning a utility off or on is a Permit Required Operation. Closing a facility or part of a facility is a Permit Required Operation. Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer. Utility outages and facility closures must be approved by the Contracting Officer before outages and closures begin. The Contractor shall obtain this approval by submitting a written Request for Utility Outage/Facility Closure Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer fourteen (14) calendar days in advance of the planned outage or closure, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with key Center activities, and keep Center impact to a minimum.

The permit, a FACILITY OUTAGES AND CLOSURES APPROVAL (form DFRC-113), must be filled out by the Government and attached to the Contractor's Request for Utility Outage/Facility Closure Permit. This package must be reviewed and approved by the Center's Safety Office, the Facilities Engineering & Asset Management Office, the affected Building/Area Manager, and the Contracting Officer prior to initiation of the outage or closure. Notification must also be made to the AFRC Security Office, the AFRC Information Systems Branch, and Center Management. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the work requiring an outage or closure in accordance with the approved permit documents. The Contractor shall also comply with the requirements stated below.

The shut-down and start-up of the utilities for the outage shall be performed by the Government and not the Contractor.

Contractors shall not shut down, shut off, disconnect, block, or otherwise

impair any fire protection sprinkler system, fire hydrant, fire alarm system, special extinguishing or other installed fire protection system. The Government will provide support for these activities only with an approved FACILITY OUTAGES AND CLOSURES APPROVAL (form DFRC-113).

1.17.4 Crane Operations

Operating a crane is a Permit Required Operation. Setting up a crane is a Permit Required Operation. Cranes shall not be operated without written permission from the Contracting Officer. Crane operations must be approved by the Contracting Officer before crane setup begins. The Contractor shall obtain this approval by submitting a written Request for Crane Operation Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer seven (7) calendar days in advance of the planned crane operation to enable the Contracting Officer to review measures being taken to prevent hazard to employees and the public, to prevent interruption of any required service, to coordinate the required work with key Center activities, and keep Center impact to a minimum.

The permit, a CRANE OPERATION APPROVAL (D-WK-800-8), must be filled out by the Government and attached to the Contractor's Plans. The contractor shall prepare the following plans/documents:

1. Description of Work,

List the work to be accomplished during the lifting operation

2. Center Impact Analysis,

List the affects this activity will have on Center occupants and Center operations, i.e. evacuate portions of a building, close a fire lane, require special secure access, close a building exit/entrance, etc.

3. Activity Hazard Analysis

Per paragraph 1.9.1

4. Lift Plan

a. The exact size and weight of the load.

b. The maximum load limits for the entire range of the lift.

c. Height of the lift.

d. The lift geometry and sequence of actions.

e. The load radius.

f. The boom length and angle, for the entire range of the lift.

g. Ground conditions and outrigger and mats requirements.

h. A drawing showing the location of the crane and the "from" and "to" pick points, including adjacent buildings, utilities, and other obstructions or hazards.

i. Rigging procedures and rigging hardware.

j. Proof of qualification for the crane operator, including a current physician's certificate that meets the requirements of USACE EM 385-1-1, Appendix G (Procedures for the Examination and Qualification of Crane Operators).

k. Environmental conditions under which lift operations are to be stopped.

l. Communication and coordination requirements.

m. The Contractor shall make Personnel Assignments and clearly list by name who will be the Lift Director, Crane Operator, Signalman, Rigger, and Tag Line Persons.

n. The Contractor shall also complete the Crane Safety Checklist prior to commencing lifting operations.

o. The Contractor shall perform a practice pick without the load to verify estimated boom angle(s) required to pick, rotate, and set the load.

This package must be reviewed and approved by the Lift Supervisor and the Chief of Facilities Engineering & Asset Management Office prior to initiation of the crane setup. The Chief of Facilities Engineering & Asset Management Office will assign the Lift Supervisor. Notification must also be made, by NASA project personnel, to the AFRC Security Office, the AFRC Safety Office, and Center Management prior to lifting operations. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the crane operation in accordance with the approved permit documents.

Crane Safety Checklist for Facility Lifts:

Things to check

1. Crane certifications and documents have been checked and are current, including:
    a. Current physician's certificate.
    b. Insurance.
    c. Pre-lift Safety Meeting minutes.
2. Operator certifications have been checked and are current.
3. Ancillary lifting equipment certifications (slings, chokers, etc.) are current.
4. Boom angle needed to reach both pick point and set points have been checked and capacity of the crane (AT THOSE BOOM ANGLES) is sufficient to lift the intended load.
5. Capacity of the crane at the horizontal angles required for the pick, rotation, and set have been checked against crane manual and capacity is sufficient for the intended load. (Note: Some cranes, especially crawler cranes that don't have outriggers, DO NOT have the same capacity to the side that they do to the front.)
6. There is sufficient room for crane counterweights to miss all obstructions when the crane rotates horizontally.
7. Clip on crane hook has sufficient spring tension.
8. All people in area are wearing hard hats and safety shoes.
9. Person who is signaling crane operator has been designated and everyone understands who that person is for this operation.
10. Lift Supervisor has been designated and everyone understands who

that person is for this operation.
11. Personnel handling tag lines have been designated and they understand that they are not allowed under the load.
12. Ground where outriggers are set has sufficient capacity to resist "punching shear" force which is generated from load and expected geometric configuration of crane.
13. Check for overhead electrical lines within boom radius + 20 feet. Brief the Chief, Facilities Engineering & Asset Management Office on proposed mitigation procedures.
14. Check for underground vaults, tanks, or utilities near the crane location that might collapse or shift causing the crane to shift or sink while under load.
15. Ensure the lifting/hazardous zone is delineated clearly to public (use cones, caution tape, fencing, or other.)

Things to do

1. Practice pick shall be made prior to actual lift in order to verify estimated boom angle(s) required to pick the load, rotate the load, and set the load. (Note: This is done without the load.)

1.17.5 Open Flame and Hot Work

The use of an open flame is a Permit Required Operation. Hot work such as welding, torch cutting, sawing metals, flame cutting, burning, grinding, brazing, soldering, and cad welding are all Permit Required Operations. Applying, installing, or removing building materials through the use of heat are also Permit Required Operations. Any operation that can result in the generation of hot flying debris or sparks is a Permit Required Operation. During operations involving possible fire hazard, the Contractor shall notify the Contracting Officer and not proceed until approval is obtained in writing. Open flame and hot work operations must be in compliance with NFPA 51B, and approved by the Contracting Officer before operations begin. The Contractor shall obtain this approval by submitting a written Request for Open Flame and Hot Work Permit in accordance with Paragraph 1.17 "PERMIT REQUIRED OPERATIONS". The Contractor shall submit this request to the Contracting Officer three (3) calendar days prior to the start of these operations, to enable the Contracting Officer to review measures being taken to prevent hazard to employees, prevent possible fire damage to equipment and property, and prevent unnecessary activation of fire suppression/alarm systems.

The permit, a USAF WELDING, CUTTING AND BRAZING PERMIT, (AF Form 592), must be filled out by the Government and attached to the Contractor's Request for Open Flame and Hot Work Permit. This package must be reviewed and approved by the AFRC Safety Office and approved by the Contracting Officer prior to start of open flame and hot work. After obtaining the approved permit package from the Contracting Officer, the Contractor shall proceed with the open flame and hot work operation in accordance with the approved permit documents. The Contractor or Subcontractor performing the operation shall sign the permit before any open flame and hot work operation is started. The Contractor shall also comply with the requirements stated below.

The Contractor shall discontinue open flame or hot work operations 60 minutes prior to the end of the normal work day. A Contractor employee shall be assigned as Fire Watchman for every open flame and hot work operation. The Watchman shall be equipped with suitable fire extinguishers and shall check all areas around and below the welding or burning operation

for fires. The check shall be continued for at least 60 minutes after completion of the open flame or hot work operation to ensure no possible sources of latent combustion, this requirement may be reduced to no less than 30 minutes by the CO based on the fire hazard.

The Contractor shall provide portable fire extinguishers for fire safety during open flame and hot work operations. When conducting open flame and hot work operations on roofs, the Contractor shall provide and be equipped with one full 20 pound 20-A:120 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. For all other open flame and hot work operations the Contractor shall provide and be equipped with one full 10 pound 4-A:60 BC multipurpose dry chemical fire extinguisher and one 2.5 gallon water pressure/spray-pump type portable fire extinguisher placed within 30 feet of the operation. The Contracting Officer may request a standby from the Local Fire Department; this accommodation does not relieve the Contractor of responsibility for open flame and hot work safety.

Upon completion of open flame or hot work operation (or expiration of Permit), the permit shall be returned to the government.

1.17.6 Energized Electrical Work

Work on an energized electrical system is a Permit Required Operation. Whenever possible, all lines, circuits, and equipment to be worked on shall be de-energized before work is started. If work must be performed on an energized electrical system that cannot be shut-down and the system will remain energized during the work, the Contractor shall submit a Request for Energized Electrical Work Permit to the Contracting Officer.

Request for Energized Electrical Work Permit shall include:

1. Description of circuit, equipment, or job location.

2. Description of work to be done.

3. Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next Government-scheduled outage.

4. Names of personnel authorized by the Contractor to perform the work on energized electrical equipment.

If the Government determines that the Energized Electrical Work Permit is necessary, the Government will complete and attach AFRC Form D-WK 232 to the Contractor's Request for Energized Electrical Work Permit prior to approval. Approval from the Contracting Officer shall be obtained by the Contractor prior to performing work on energized lines, circuits, and equipment per "PERMIT REQUIRED OPERATIONS" instructions paragraph in this section. The Contractor shall provide and utilize all necessary personal protective equipment and other protective controls to work on energized lines, circuits, and equipment NFPA 70E.

1.18 ELECTRICAL SAFETY

Contractor shall appoint an individual responsible for the electrical safety of each work team to restrict entry to dangerous locations to those authorized by him jointly with the Government. Lockout/Tagout controls

will be strictly enforced.

The Contractor shall use Ground Fault Circuit Interrupters (GFCI) in all circuits used for electric tools and equipment in the construction site. The Contractor shall use GFCIs in all circuits used for temporary lighting in the construction site. GFCIs shall be installed in accordance with the most recent edition of the National Electric Code.

1.19 UNDERGROUND UTILITIES

Safety clearance from the Contracting Officer is required before any Contractor personnel enter a manhole. Contractor shall contact the Contracting Officer for support services at least 24 hours in advance.

Contractor shall be responsible for removing water and debris before commencement and during execution of work in manholes.

1.19.1 PROTECTION OF EXISTING UTILITIES

Existing utilities that are indicated, or the location of which is made known to the Contractor prior to beginning of operations, and utility lines constructed during the Contractor's operation, shall be protected from damage. If the Contractor damages any of these utilities they shall be repaired by the Contractor at no additional cost to the Government. In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not known to the Contractor, report thereof shall be made immediately to the Contracting Officer. If the Contracting Officer determines that repairs shall be made by the Contractor, such repairs will be ordered under the clause of the general provisions of the contract entitled "Differing Site Conditions".

1.20 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the Contracting Officer for all specialized material and equipment that could cause fatal harm to construction personnel or to the construction project.

Workers shall be protected from radiation exposure in accordance with 10 CFR 20. Standards for Protection Against Radiation.

Loss of radioactive material shall be reported immediately to the Contracting Officer.

Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5 p.m. on weekdays.

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the Contracting Officer will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process.

Use of equipment containing radioactive isotopes or any nuclear sources such as density test, moisture detectors, radiography, etc. must be approved by the AFRC Safety Office and the Contracting Officer. If such

equipment is to be used in the work, the Contractor must notify the AFRC Safety Office through the Contracting Officer no less than 14 days prior to the use of such equipment. During the use of such equipment the AFRC Safety Office is authorized to make periodic checks to insure that proper health precautions are being followed. If the AFRC Safety Office determines that these precautions are not being followed, the AFRC Safety Office will immediately notify the Contracting Officer to initiate corrective actions.

1.21 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.22 PROTECTION OF WORK

Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, the Contractor shall obtain from the Contracting Officer the current subsurface utility drawing of the particular area to be worked on. Contractor shall stake out subsurface utilities, communication cables and pipe lines indicated within the area of work.

Contractor shall notify the Contracting Officer, 48 hours prior to the start of excavation work or surface penetration, to enable the Contracting Officer to review measures being taken to prevent hazard to employees and possible damage to subsurface utilities. Where emergency conditions preclude the 48 hours advance notification, the Contractor shall immediately inform the Contracting Officer of his intention to initiate work prior to actual start of activity.

After obtaining clearance from the Contracting Officer, the Contractor shall proceed with excavating work, or other surface penetration work. Contractor shall temporarily halt any machine excavation work or other surface penetration when approaching 10 feet 3 meters of an existing utility line until the Contractor has exposed the utility line by hand excavation.

1.23 ROOFING AND COATING

At the beginning of each work day the Contractor shall check with the Contracting Officer before proceeding to work on the roof to ensure safe work conditions. Contractor shall comply with 29 CFR 1926.

1.24 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, drill hammers, generators, tractors, saws, air compressors, and explosive-activated tools, etc.) shall be scheduled for weekends and/or outside normal duty hours. Contractor operations that result in noise levels above 60 dBA in any occupied buildings (offices, laboratories, control rooms, hangars, etc.) and are disruptive to NASA/AFRC business operations shall be performed on weekends or outside normal duty hours. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work. (Normal duty hours defined in Section 01 14 00 "Work Restrictions", Paragraph 1.2.2 "Normal Duty Hours").

Contractor personnel working at NASA/AFRC may need to wear hearing protection as a result of normal aircraft operations. Sonic boom shock waves are a normal everyday occurrence at NASA/AFRC that cause momentary surprise to personnel. The Contractor shall instruct all employees to be aware of this hazard, especially working outdoors at heights or near heavy loads.

1.25 SEVERE STORM PLAN

In the event of a severe storm warning, or indications of impending severe weather (e.g. dust storms, damaging wind, heavy rains, floods, tornados, hail, or lightning) the Contractor shall monitor weather conditions and take appropriate precautions including but not limited to:

a. Secure outside equipment and materials and place materials possible to damage in protected locations.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

d. Secure materials and equipment that should not be exposed to, or contaminated with, dirt and dust to protect the materials and equipment from damage. This includes mechanical, electrical, and electronic equipment to ensure their function is not compromised. This also includes materials that have aesthetic purpose to ensure appearance is not damaged.

1.26 HAZARDOUS MATERIALS AND WASTE

When working with hazardous materials and hazardous waste, Contractor personnel must wear or use personal protective articles such as protective clothing, respiratory devices, protective shields, etc., appropriate to the task being performed. Provisions are to be made by the Contractor for continuous contact with personnel working with hazardous waste/materials in remote areas.

Contractor shall identify all wastes produced and dispose of them in the following approved manners:

Identify all wastes and waste producing processes including chemicals, paints, Petroleum, Oil and Lubricant (POL) products and solvents, and their containers. All unknown wastes shall be chemically identified.

Obtain a determination of whether the waste is hazardous from the Contracting Officer.

Notify the Contracting Officer prior to taking disposal action for any hazardous waste.

Notify the Contracting Officer of leaks or releases of ozone depleting substances in equipment with a charge of 50 pounds or more.

For disposal, provide either laboratory analysis data documenting the chemical content of the waste or certification by appropriate organization authority as to the chemical constituents of the waste. Technical assistance on disposal analysis requirements will be provided on request by

contacting the Contracting Officer.

Document the waste type, quantity, location, and personnel/contractor/ agency responsible so the material can be tracked from generation through ultimate disposal as required by Environmental Protection Agency under Resource Conservation and Recovery Act.

1.26.1 Chemicals and Hazardous Materials

No chemicals and no hazardous materials such as flammables, sources of ionizing radiation, corrosives, or toxic substances may be brought onto NASA/AFRC premises without authorization from the Contracting Officer. Provide the Contracting Officer with a copy of the Safety Data Sheets (SDSs) for all chemicals and hazardous materials to be brought on site. All manufacturer recommended precautions shall be followed during the use of any chemicals and hazardous material. SDSs will be required of all substances deemed to be hazardous by the Contracting Officer. SDSs must be submitted to the Contracting Officer for approval prior to the use of any chemicals and hazardous substance.

1.26.2 Asbestos, Lead Paint, and PCBs

Any work in or around asbestos containing material (ACM) or suspect ACM, including but not limited to insulation; fire proofing; ceiling tiles; flooring materials; roofing materials; or transite, gypsum board, plaster and hollow cell walls, must be approved by the Contracting Officer prior to commencing work.

The use of any construction materials containing asbestos is prohibited.

In the event suspect ACM is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the Contracting Officer.

Any work involving the disturbance of lead based paint or suspect lead based paint must be approved by the Contracting Officer prior to commencing work.

In the event suspect lead based paint is identified, and was not previously identified, the contractor shall immediately cease work in the vicinity and inform the Contracting Officer.

The use of any paints containing lead or zinc chromate is prohibited.

Any work involving the disturbance of PCBs must be cleared through the Contracting Officer.

1.27 BARRICADING WORK AREAS

Areas made hazardous to workers, project personnel, the public, or other persons by Contractor operations shall be barricaded as follows:

a. All lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions shall be barricaded to prevent injury to personnel and reduce the possibility of damage to moving equipment. The Contractor shall continuously barricade all lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions with temporary vertical chain link fencing or vertical plywood fencing.

b. When the lay down areas, excavations, breaks in roads, breaks in floors, and similar conditions are within 20 feet of the edge of roads, parking lots, and pedestrian routes, the Contractor shall furnish and install battery powered flasher type warning lights on a maximum spacing of not less than one flasher every 15 feet on at least one side of any excavation or opening.

c. Steel plates used to cover excavations in roadways shall be sufficient to safely support all vehicle loads.

d. Identify and flag all fire sprinkler heads when using ladders in work area.

1.28 FALL HAZARDS

When work is performed at heights which expose workers, project personnel, the public, other persons, or assets to falling objects, such areas shall be barricaded, restricted, or protected.

When work is performed at heights which expose workers, and inspectors to falls, the Contractor shall provide fall protection. The Contractor shall submit for approval to the Contracting Officer a site specific fall protection plan for each DFOW before commencing roofing work, any activity on a roof, or any activity that subjects employees to a fall of greater than 6 feet or a fall into an inherent hazard. The Contractor shall ensure safe work conditions during such work, including safety provisions for wall openings, floor openings, and unguarded edges. When working from an aerial lift workers shall use a body harness and lanyard system appropriately attached to the manufacturer's attachment point(s).

Per 29 CFR 1926.501, each employee on a walking/working surface with an unprotected side or edge which is 6 feet or more in height above a lower level shall be protected from falling by a system correctly suited to the area of hazard (e.g. guardrail system, safety net system, or personal fall arrest system, etc.).

1.29 PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

All construction areas at AFRC are considered hard hat areas. All persons working on or visiting the project site shall wear hard hats (Type I or Type II per ANSI/ISEA Z89.1), and be used in accordance with manufacturers recommendations concerning: inspection, maintenance, donning and useful life span.

All Contractor employees and Subcontractors shall wear clothing suitable for the weather and work conditions. The minimum for field work shall be short sleeve shirt, long trousers, and appropriate hard-toed safety boots per (ASTM F2412 & ASTM F2413). Additional equipment shall be worn as necessary by work conditions, including safety glasses, face shields, shade lenses, and other PPE specified in this section.

For purposes of inspecting the work under this contract, the Contractor shall provide personal protective and safety equipment to the Government inspector for use during inspections. This includes but is not limited to personal fall protection systems (such as body harnesses, lanyards, lifelines), ladders, aerial lifts, hearing protection, respirators, safety glasses, face shields, shade lenses, etc. This does not include hard hats and steel-toed safety boots.

1.30 ENVIRONMENTAL PROTECTION

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract shall be protected during the entire period of this contract.

1.30.1 Desert Tortoise Protection

The Desert Tortoise is a threatened species under the Federal Endangered Species Act, and the Contractor shall ensure that they are protected throughout the project site. For work sites outside the NASA AFRC fenceline, but within the lease boundary, the superintendent and all contract employees involved in earthwork operations shall view a NASA training film about the Desert Tortoise, approximately 1 hour long. The Contractor shall take extreme care to protect the Desert Tortoise when in the clean soil disposal site.

1.30.2 Migratory Birds

Migratory birds nest in the area yearly and are protected under the Migratory Bird Treaty Act (MBTA). Nests may occur on the ground, in burrows or culverts, in vegetation (such as cattails), or on manmade structures (such as buildings, radar towers, static plane displays, catwalks, rafters, pipe, etc.). If an active bird nest (nest with eggs, unfledged birds, or adult birds observed in the nest) is found within the project area and cannot be avoided, Contractor shall cease work immediately and notify the Contracting Officer.

1.30.3 Cultural Resource Protection

In order to avoid disturbing sensitive or historical materials/artifacts, Contractor shall use existing graded or permanent roads and staging areas and avoid accessing the lakebed. Contracting Officer may allow additional access inside the project boundary, or adjust the project boundary as necessary.

In the event cultural or historical materials are found during the performance of this contract, work will cease immediately in the find area and the Contracting Officer shall be notified accordingly.

1.30.4 Air Quality

The Contractor's operations shall satisfy air quality requirements for Kern County Air Pollution Control District, including permits for all temporary, portable construction equipment with internal combustion engines rated over 50 bhp.

1.30.5 Water Quality

The Contractor's operations shall satisfy water quality requirements for the Lahontan Regional Water Quality Control Board.

1.31 DUST CONTROL

The Contractor shall maintain excavations, embankments, stockpiles, temporary roads, plant sites, waste areas, borrow areas, and other work areas within or beyond the project site free from dust which would cause a hazard or nuisance to others. Methods of stabilization consisting of water sprinkling, chemical treatment, light bituminous treatment or similar

methods will be permitted to control dust. Sprinkling shall be repeated at such intervals as to keep the disturbed area damp at all times. Dust control shall be performed as the work proceeds and whenever a nuisance or hazard occurs.

When the jobsite is inside an occupied building, the Contractor shall provide and install dust barriers to control dust movement so that dirt and dust does not migrate out of the construction site and into occupied sections of the building. Any corridors, offices, and other rooms that become contaminated by dirt and dust migrating from the Contractor's activity shall be cleaned, dusted, and vacuumed by the Contractor at no expense to the Government.

1.32 FIRST AID AND EMERGENCIES

The contractor shall maintain a 16-unit first aid kit on the job site clearly located and marked. The Contractor's Site Safety Officer shall inspect the kit every work day; see Paragraph 1.12.2 "Daily Safety Meetings/Daily Safety Inspections".

Contractor personnel who sustain injury or become ill, on-site during normal duty hours, may be examined and/or given first aid treatment at the NASA/AFRC Dispensary in Building 4822, telephone (661) 276-3258 or (661) 276-3570. Outside normal duty hours the Contractor is responsible for first aid treatment of employees and transportation to a medical facility off-site. All injuries sustained on-site must be reported to the Contracting Officer whether treated at the NASA/AFRC facility or elsewhere. (Normal duty hours are defined in Section 01 14 00 "Work Restrictions".)

Emergency telephone numbers and reporting instructions shall be conspicuously posted at the job site. Fire, rescue, and first aid are available by contacting 911 on a NASA/AFRC telephone. If a NASA/AFRC phone is not available in an emergency, call Security post 1 at (661) 276-3256 and clearly explain the emergency. A direct 911 contact cannot be made by use of a personal or cellular phone. To summarize, in an emergency from:

a. NASA/AFRC phone	dial	911
b. Personal or Cellular phone	dial	(661) 276-3256

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 35 40.00 20

ENVIRONMENTAL MANAGEMENT
02/10

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 Z400.1/Z129.1	(2010) Hazardous Workplace Chemicals - Hazard Evaluation and Safety Data Sheet and Precautionary Labeling Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	(1999; R 2010) Sampling Chain-Of-Custody Procedures
ASTM D 5663	(1997; R 2003) Validating Recycled Content in Packaging Paper and Paperboard
ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Biomass R&D Act	(2000) Biomass Research and Development Act
U.S. Farm Bill	(2002) U.S. Farm Bill of May 2002

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	(1972; R 2005) National Pollutant Discharge Elimination System

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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

40 CFR	Protection of Environment
40 CFR 261	Identification and Listing of Hazardous Waste

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Biobased content" is calculated as the weight of the biobased material divided by the total weight of the product, and is expressed as a percentage by weight.

b. "Biobased materials" include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by the Biomass R&D Act. Minimum biobased content shall be as defined in the U.S. Farm Bill.

c. "Chain-of-custody" is a process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

d. "Pollution and environmental damage" is caused by the presence of chemical, physical, or biological elements or agents. Human health or welfare is adversely affected; ecological balances are unfavorably altered; the utility of the environment for aesthetic, cultural, or historical purposes degrades.

1.3 PRECONSTRUCTION MEETING

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the Contracting Officer to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental protection. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting as specified in Section 01 45 00.10 40 CONTRACTOR QUALITY CONTROL.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

Instructor Qualifications

Submit reference data to demonstrate instructors' individual and firm's capabilities and experience.

SD-03 Product Data

Packaging; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-06 Test Reports

Field Quality Control Reports

SD-07 Certificates

Environmental Regulatory Requirements

For Government's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with environmental regulations bearing on performance of the work.

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-11 Closeout Submittals

Training Program

Submit two copies of instructional program outline for demonstration and training, including a schedule of dates, times, length of instruction, instructors' names, learning objective, and teaching outline for each training module. At completion of training, submit two complete training manuals for Government's use, and a list of participants with each participant's results of performance-based test for each training module. For Government's records, submit Contractor 40 CFR employee training records.

Protection of Natural Resources

Contractor's NPDES/SWPPP

1.5 CONTRACTOR'S ENVIRONMENTAL MANAGER

Designate an on-site Environmental Manager responsible for overseeing the environmental goals for the project and implementing procedures for environmental protection.

1.5.1 Duties

The Environmental Manager shall be responsible for the following:

a. Compliance with applicable federal, state, and local environmental regulations, including maintaining required documentation.

b. Implementation of the Waste Management Plan.

c. Implementation of the Indoor Air Quality (IAQ) Management Plan.

d. Implementation of the Environmental Protection Plan.

e. Environmental training for Contractor personnel in accordance with their position requirements.

f. Monitoring and documentation of environmental procedures.

1.5.2 Qualifications

Minimum 5 years construction experience on projects of similar size and scope; minimum 2 years' experience with environmental procedures similar to those of this project; familiarity with environmental regulations applicable to construction operations.

1.6 ENVIRONMENTAL REGULATORY REQUIREMENTS

The Contractor shall be responsible for knowing federal, state, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. Comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

1.7 ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.7.1 Safety Data Sheets (SDS)

Submit an SDS for each product specified in other sections or required by OSHA to have an SDS. SDS shall be prepared within the previous five years. Include information for SDS Sections 1 through 16 in accordance with ANSI Z400.1/Z129.1 and as follows:

a. Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the SDS.

b. Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.

c. Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

d. Section 14: Identify hazard class for shipping.

e. Section 15: Identify federal, state, and local regulations applicable to the material.

f. Section 16: Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date SDS was prepared.

1.8 ENVIRONMENTAL PROTECTION PLAN

Prepare and submit an Environmental Protection Plan not less than 10 days before the preconstruction meeting. At a minimum, address the following elements in accordance with this section:

a. Identification and contact information for Environmental Manager.

b. General site information, including preconstruction description

and photographs.

c. Summary of training program.

d. Procedures to address water resources.

e. Procedures to address land resources.

f. Procedures to address air resources.

g. Procedures to address fish and wildlife resources.

h. Monitoring and quality control procedures.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

1.9 ENVIRONMENTAL DEMONSTRATION AND TRAINING

Contractor shall provide environmental training for workers performing work on the project site.

1.9.1 Instructor Qualifications

Training shall be given by a firm or individual experienced in providing training or education similar in content and extent to that indicated for this project.

1.9.2 Coordination

Coordinate instruction schedule with Government operations. Adjust schedule as required to minimize disruption of Government operations. Coordinate instruction with demonstration and training of general building systems.

1.9.3 Training Program

Develop a training program for all site workers that includes the following topics:

a. Overview of environmental and sustainability issues related to the building industry.

b. Overview of environmental and sustainability issues related to the project.

c. Compliance with applicable federal, state, and local environmental regulations.

d. Review of site specific procedures and management plans implemented during construction, including the Waste Management Plan, Indoor Air Quality (IAQ) Management Plan, Environmental Protection Plan, and procedures for noise and acoustics management.

1.9.3.1 Scheduling

Provide instruction at mutually agreeable time(s).

1.9.3.2 Training Modules

Develop a learning objective and teaching outline for each topic in the Training Program. Include a description of specific skills and knowledge that each participant is expected to acquire. Instructors shall be well-versed in the particular topics that they are presenting.

1.9.3.3 Evaluation

At the conclusion of each training module, assess and document each participant's understanding of the module by use of an oral performance-based test.

PART 2 PRODUCTS

2.1 ENVIRONMENTALLY PREFERABLE PRODUCTS

Consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of products, and provide products and materials with the least effect on the environment, determined by LCA analysis, released toxins, and other methods.

2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls (PCBs).

d. Products containing chlorinated fluorocarbons.

e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.

f. Paint containing more than 0.06 percent lead.

2.1.2 Packaging

Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging, and to manufacturers with policies that take back product packaging.

2.1.2.1 Industrial Paperboard

Minimum 45 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.2 Carrier Board

Minimum 10 percent recycled content with a minimum of 10 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.3 Brown Papers

Minimum 5 percent recycled content with a minimum of 5 percent

post-consumer recycled content in accordance with ASTM D 5663.

2.1.3 Substitutions

Notify the Contracting Officer when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents, but which are more environmentally responsible than materials, equipment, or products specified or indicated in the Contract Documents. Submit the following for initial review by the Contracting Officer:

a. Product data including manufacturer's name, address, and phone number.

b. Description of environmental advantages of proposed substitution over specified product.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the Contracting Officer. Where violation of environmental procedures requirements will irreversibly damage the site, documentation of progress shall be required at intervals determined by the Contracting Officer.

3.1.1 General Disturbance

Confine demolition and construction activities to work area limits indicated on the Drawings. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways. Burning is prohibited.

3.1.2 Water Resources

The Contractor's NPDES/SWPPP shall comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). In California this is known as the "State Water Pollution Prevention Plan" (SWPPP). Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Store and service construction equipment at areas designated for collection of oil wastes. Prevent ponding of stagnant water conducive to mosquito breeding habitat. Prevent run-off from site during demolition and construction operations.

3.1.3 Land Resources

Prior to construction, identify land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the Contracting Officer. Coordinate protection practices with work specified in Division 2 SITEWORK.

3.1.3.1 Erodible Soils

Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas. Clear areas in reasonably sized increments only as needed to use the areas developed. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

3.1.3.2 Erosion and Sedimentation Control Devices

Construct or install temporary and permanent erosion and sedimentation control features as required.

3.1.3.3 Tree and Plant Protection

Protect as specified in Division 2 SITEWORK and as specified. Prior to start of construction, tag each tree and plant scheduled to remain. In the event of damage to tree or plant, the Government may, at the Contracting Officer's discretion, deduct the indicated value of the damaged tree or plant from the Contract Sum.

3.1.4 Air Resources

Comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

d. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.

e. Properly maintain equipment to reduce gaseous and particulate pollutant emissions.

3.1.5 Fish and Wildlife Resources

Manage and control construction activities to minimize interference with and damage to wildlife. Do not disturb wildlife. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the survival of wildlife, except as indicated or specified.

3.2 FIELD QUALITY CONTROL

Comply with requirements of agencies having jurisdiction and as specified

herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
08/10

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-600-0355
Fax: 703-562-1942
E-mail: fdietz@ahrinet.org
Internet: http://www.ahrinet.org

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
E-mail: doccenter@atis.org
Internet: http://www.atis.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806

E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020 or 513-742-6163
Fax: 513-742-3355
E-mail: mail@acgih.org
Internet: http://www.acgih.org

AMERICAN HARDBOARD ASSOCIATION (AHA)
c/o Composite Panel Association
19465 Deerfield Ave., Suite 306
Leesburg, VA 20176
Ph: 703-724-1128
Fax: 703-724-1588
Internet: http://www.pbmdf.org

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031
Tel: 703-849-8888
Fax: 703-207-3561
E-mail: infonet@aiha.org
Internet http://www.aiha.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403
Publications: 800-644-2400
E-mail: pubs@aisc.org
Internet: http://www.aisc.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1140 Connecticut Avenue, NW, Suite 705
Washington, DC 20036
Ph: 202-452-7100
Fax: 202-463-6577
E-mail: webmaster@steel.org
Internet: http://www.steel.org

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)
P.O. Box 210
Germantown, MD 20875-0210
Ph: 301-972-1700
Fax: 301-540-8004
E-mail: alsc@alsc.org
Internet: http://www.alsc.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org
Internet: http://www.ansi.org/

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)
10003 Derekwood Lane, Suite 210
Lanham, MD 20706
Ph: 301-459-3200
Fax: 301-459-8077
Internet: http://www.arema.org

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6333
E-mail: member@asce.org
Internet: http://www.asce.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: http://www.ashrae.org

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
1800 East Oakton Street
Des Plaines, IL 60018-2187
Ph: 847-699-2929
Fax: 847-768-3434
E-mail: customerservice@asse.org
Internet: http://www.asse.org

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy Avenue
Denver, CO 80235
Ph: 800-926-7337
Fax: 303-347-0804
E-mail: smorrison@awwa.org
Internet: http://www.awwa.org

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
E-mail: info@aws.org or customerservice@awspubs.com
Internet: http://www.aws.org

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
P.O. Box 361784
Birmingham, AL 35236-1784
Ph: 205-733-4077
Fax: 205-733-4075
E-mail: email@awpa.com
Internet: http://www.awpa.com

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
7011 South 19th St.
Tacoma, WA 98466-5333
Ph: 253-565-6600
Fax: 253-565-7265
E-mail: help@apawood.org
Internet: http://www.apawood.org

ASME INTERNATIONAL (ASME)
Three Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-854-7179 or 800-843-2763
Fax: 212-591-7674
E-mail: infocentral@asme.org
Internet: http://www.asme.org

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)
529 14th Street, NW
Washington D.C. 20045
Ph: 202-207-0917
Fax: 202-223-9741
Internet: http://www.asphaltroofing.org

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
E-Mail: aeicdir@bellsouth.net
Internet: http://www.aeic.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: http://www.astm.org

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Avenue
15th Floor
New York, NY 10017
Ph: 212-297-2122
Fax: 212-370-9047
E-mail: assocmgmt@aol.com
Internet: http://www.buildershardware.com

CARPET AND RUG INSTITUTE (CRI)
P.O. Box 2048
Dalton, GA 30722-2048
Ph: 800-882-8846 or 706-278-3176
Fax: 706-278-8835
Internet: http://www.carpet-rug.com

COMPOSITE PANEL ASSOCIATION (CPA)
19465 Deerfield Avenue, Suite 306
Leesburg, VA 20176

Ph: 703-724-1128
Fax: 703-724-1588
Internet: http://www.pbmdf.com

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
2500 Wilson Boulevard
Arlington, VA 22201-3834
Ph: 703-907-7500
Fax: 703-907-7501
E-mail: infor@ecaus.org
Internet: http://www.eia.org

FM GLOBAL (FM)
270 Central Avenue
P.O. Box 7500
Johnston, RI 02919
Ph: 401-275-3000 ext. 1945
Fax: 401-275-3029
E-mail: servicedesk.myrisk@fmglobal.com
Internet: http://www.fmglobal.com

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
University of South California
Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032 or 866-545-6340
Fax: 213-740-8399
E-mail: fccchr@usc.edu
Internet: http://www.usc.edu/dept/fccchr

GREEN SEAL (GS)
1001 Connecticut Avenue, NW
Suite 827
Washington, DC 20036-5525
Ph: 202-872-6400
Fax: 202-872-4324
E-mail: greenseal@greenseal.org
Internet: http://www.greenseal.org

GYPSUM ASSOCIATION (GA)
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782
Ph: 301-277-8686
Fax: 301-277-8747
E-mail: info@gypsum.org
Internet: http://www.gypsum.org

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
E-mail: isea@safety equipment.org
Internet: http://www.safetyequipment.org/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane or 2001 L Street, NW. Suite 700
Piscataway, NJ 08855-1331 or Washington, DC 20036-4910 USA

Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-6380
E-mail: onlinesupport@ieee.org or ieeeusa@ieee.org
Internet: http://www.ieee.org

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 1 800 447 3352
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Internet: www.iccsafe.org

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Internet: http://www.netaworld.org

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Internet: http://www.iec.ch

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Internet: http://www.naamm.org

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Internet: http://www.nrca.net

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Internet: http://www.nelma.org

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Internet: http://www.oecd.org
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Internet: http://www.spri.org

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
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Ph: 724-776-4970
Fax: 724-776-0790
E-mail: customerservice@sae.org
Internet: http://www.sae.org

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400 Penn Center Boulevard, Suite 530
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Ph: 412-829-0770
Fax: 412-829-0844
Internet: http://www.cypressinfo.org

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Pensacola, FL 32504-0915
Ph: 850-434-2611
Fax: 850-433-5594
E-mail: Fill out form at http://www.spib.org/contact.shtml
Internet: http://www.spib.org

STATE OF VIRGINIA ADMINISTRATIVE CODE (VAC)
Virginia Code Commission
General Assembly Building, 2nd Floor
910 Capitol Street
Richmond, Virginia 23219
Ph: 804-786-3591
Fax: 804-692-0625
E-mail: tlong@dls.virginia.gov (Tina Long)
Internet: http://leg1.state.va.us/000/srr.htm

STEEL DOOR INSTITUTE (SDI/DOOR)
c/o Steel Door Institute
30200 Detroit Road
Cleveland, OH 44145-1967
Ph: 440-899-0010
Fax: 440-892-1404
E-mail: info@steeldoor.org
Internet: http://www.steeldoor.org

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Ph: 412-281-2331
Fax: 412-281-9992
E-mail: info@sspc.org
Internet: http://www.sspc.org

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2500 Wilson Blvd,. Suite 300
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
Internet: http://www.tiaonline.org

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Tigard, OR 97281
Ph: 503-639-0651
Fax: 503-684-8928
E-mail: info@wclib.org
Internet: http://www.wclib.org

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
Yeon Building
522 SW 5th Avenue
Suite 500
Portland, OR 97204-2122
Ph: 503-224-3930
Fax: 503-224-3934
E-mail: info@wwpa.org
Internet: http://www.wwpa.org

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.10 40

CONTRACTOR QUALITY CONTROL
02/10

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

QC Plan; G

Submit a QC plan within 15 calendar days after receipt of Notice to Proceed (NTP).

1.3 INFORMATION FOR THE CONTRACTING OFFICER (CO)

During construction, report forms to be used include: Contractor Quality Control (CQC) Report, Preparatory Phase Checklist, Initial Phase Checklist, Discrepancy List, and Testing Plan and Log.

Deliver the following to the CO:

a. CQC Report: Original and one copy, by 10:00 AM the next working day after each day that work is performed;

c. Preparatory Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

d. Initial Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

e. Field Test Reports (per the Testing Plan & Log): One copy, within two working days after the test is performed, attached to the CQC Report;

f. QC Meeting Minutes: One copy, within two working days after the meeting; and

g. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a QC plan, participation in weekly project meetings, QC meetings, three phases of control, submittal review and approval, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site.

1.4.1 Preliminary Work Authorized Prior to Acceptance

The only work that is authorized to proceed prior to the acceptance of the QC plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.2 Acceptance

Acceptance of the QC plan is required prior to the start of construction. The CO reserves the right to require changes in the QC plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The CO reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications.

1.4.3 Notification of Changes

Notify the CO, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the CO.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The QC Manager is required to attend the weekly project meetings, conduct the QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by others.

1.5.1.2 Qualifications

An individual with a minimum of 5 years combined experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this contract. The individual must be familiar with the requirements of the EM 385-1-1 and have experience in the areas of hazard identification and safety compliance.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC

Manager shall have completed the US Army Corps of Engineers course "Construction Quality Management for Contractors" and will have a current certificate.

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

1.6 QC PLAN

1.6.1 Requirements

Provide, for acceptance by the CO, a QC plan submitted in a three-ring binder that covers both on-site and off-site work and includes the following with a table of contents listing the major sections identified with tabs.

I. QC ORGANIZATION: A chart showing the QC organizational structure and its relationship to the production side of the organization.

II. NAMES AND QUALIFICATIONS: In resume format, for each person in the QC organization. Include the CQM for Contractors course certification required by the paragraph entitled "Construction Quality Management Training".

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONAL: Of each person in the QC organization.

IV. OUTSIDE ORGANIZATIONS: A listing of outside organizations such as consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

V. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for managing and implementing the QC program as described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval.

VII. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

VIII. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

IX. PROCEDURES TO COMPLETE DISCREPANCY LIST: Procedures to identify,

record, track and complete discrepancies.

X. DOCUMENTATION PROCEDURES: Use Government formats.

XI. LIST OF DEFINABLE FEATURES OF WORK: A Definable Feature of Work (DFOW) is a task, which is separate and distinct from other tasks, has the same control requirements and work crews. The list shall be cross-referenced to the Contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule.

XII. PROCEDURES FOR PERFORMING THREE PHASES OF CONTROL: For each DFOW provide Preparatory and Initial Phase Checklists. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents. The preparatory and initial phases shall be conducted with a view towards obtaining quality construction by planning ahead and identifying potential problems.

XIII. PROCEDURES FOR COMPLETION INSPECTION: See the paragraph entitled "COMPLETION INSPECTIONS".

1.7 QC MEETINGS

After the start of construction, during the weekly project meetings Quality Control shall be addressed at the work site with the superintendent, QC Manager and the foreman responsible for the ongoing and upcoming work. The Contractor shall prepare the minutes of the meeting and provide a copy to the CO within two working days after the meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work and rework;

c. Review the status of submittals;

d. Review the work to be accomplished in the next two weeks and documentation required;

e. Resolve QC and production problems (RFIs, etc.);

f. Address items that may require revising the QC plan; and

g. Review Accident Prevention Plan (APP).

1.8 THREE PHASES OF CONTROL

The three phases of control shall adequately cover both on-site and off-site work and shall include the following for each DFOW.

1.8.1 Preparatory Phase

Notify the CO at least five work days in advance of each preparatory phase. Conduct the preparatory phase with the superintendent and the foreman responsible for the definable feature of work. Document the results of the preparatory phase actions in the daily CQC Report and in the QC checklist. Perform the following prior to beginning work on each

definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS), formerly Material Safety Data Sheets (MSDS), are submitted; and

h. Discuss specific controls used and the construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

1.8.2 Initial Phase

Notify the CO at least five work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the Initial Phase with the foreman responsible for that DFOW. Observe the initial segment of the work to ensure that it complies with contract requirements. Document the results of the Initial Phase in the daily CQC Report and in the QC checklist. Perform the following for each DFOW:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Ensure that testing is performed by the approved laboratory; and

d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

1.8.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC Report and in the QC checklist:

a. Ensure the work is in compliance with contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by the approved laboratory;

d. Ensure that discrepancies are being corrected; and

e. Assure manufacturers' representatives have performed necessary inspections, if required.

1.8.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.8.5 Notification of Three Phases of Control for Off-Site Work

Notify the CO at least two weeks prior to the start of the preparatory and initial phases.

1.9 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review, and approval of submittals are described in the submittal section of the specification.

1.10 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this contract.

1.10.1 Accreditation Requirements

Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E 329, C 1077, D 3666, D 3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

1.10.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology, the American Association of State Highway and Transportation Officials (AASHTO), International Accreditation Services, Inc. (IAS), U. S. Army Corps of Engineers Materials Testing Center (MTC), and the American Association for Laboratory Accreditation (A2LA).

1.10.3 Capability Check

The CO retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this contract.

1.10.4 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the CO immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the CO.

1.11 QC CERTIFICATIONS

1.11.1 Contractor Quality Control Report Certification

Each CQC Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report."

1.11.2 Completion Certification

Upon completion of work under this contract, the QC Manager shall furnish a certificate to the CO attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

1.12 COMPLETION INSPECTIONS

1.12.1 GOVERNMENT INSPECTION

Government in-process and end-item inspections will be performed at the construction site and at the Contractor's and/or subcontractor(s)' facilities by a designated Government representative to assure compliance with the contract requirements, drawings, and technical specifications. The extent of such inspection will depend upon the level of quality and workmanship of the items. The Contractor shall notify the Contracting Officer of scheduled inspections a minimum of 48 hours prior to such scheduled inspections.

The Contractor shall give 24-hour advance notice to the Contracting Officer of the date when the contract work will begin at the site to allow coordination with the inspection staff. Should the Contractor unexpectedly suspend work at any time prior to completion of the contract, the Contractor shall notify the Contracting Officer as soon as possible. If work is suspended for 3 days or longer, the Contractor shall not resume work without notifying the Contracting Officer 24-hours in advance.

1.12.2 Discrepancy List Inspection

Near the completion of all work or any increment thereof the CQC Manager shall conduct an inspection of the work and develop a Discrepancy List of items which do not conform to the approved drawings and specifications. The discrepancy list shall include the estimated date by which the deficiencies will be corrected. A copy of the Discrepancy List shall be provided to the Government. The CQC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. The Contractor shall then notify the Government that the facility is ready for the Government

inspection.

1.12.3 Pre-Final Inspection

The QC manager will perform this inspection to verify that the facility is complete and ready to be occupied. The QC Manager shall ensure that all items on this Discrepancy List are corrected prior to notifying the Government that a "Final" inspection with the customer can be scheduled.

1.12.4 Final Acceptance Inspection

The QC Manager, the superintendent, or other Contractor management personnel, COR and the CO will be in attendance at this inspection. Additional Government personnel may be in attendance. Notice shall be given by the CO at least 14 days prior to the Final Punch List inspection. The Final Punch List inspection will be formally scheduled by the CO. The notice shall state that all specific items previously identified to the Contractor as being unacceptable will be complete by the date scheduled for the Final Punch List inspection.

1.13 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER (CO)" shall be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the contract. The superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work shall be identified by terminology consistent with the construction schedule. In the "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site. For each remark given, identify the Schedule Activity No. that is associated with the remark.

1.13.1 Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders shall be readily available to the Government's Quality Assurance Team during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections, arranged by Activity/Event Number.

c. A current up-to-date copy of the Testing and Plan Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that the modified work was accomplished.

e. A current up-to-date copy of the Discrepancy List, corrective action plan, and documentation of corrections made to defective

work.

f. Maintain up-to-date copies of all punch lists issued by the QC Staff on the Contractor and Sub-Contractors and all punch lists issued by the Government.

1.13.2 As-Built Drawings

The QC Manager shall review the as-built drawings, as required in Section 01 78 00 CLOSEOUT SUBMITTALS, to ensure they are kept current on a daily basis and marked to show deviations from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. modification number, RFI number, etc.). The QC Manager shall initial each deviation or revision that was approved by the CO. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the CO.

The Contractor shall maintain at the jobsite two working sets of full-size prints of the contract drawings, accurately marked in red with adequate dimensions, to show all variations between the construction actually provided and that indicated or specified in the contract documents, including buried or concealed construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the contract drawings. Existing utility lines and features revealed during the course of construction shall also be accurately located and dimensioned. Variations in the interior utility systems shall be clearly defined and dimensioned; and coordinated with exterior utility connections at the building five-foot line, where applicable. Existing topographic features which differ from those shown on the contract drawings shall also be accurately located and recorded. Where a choice of materials or methods is permitted herein, or where variations in scope or character of methods is permitted herein, or where variations in scope or character of work from that of the original contract are authorized, the drawings shall be marked to define the construction actually provided. The representations of such changes shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as necessary to clearly portray the as-built construction.

These drawings shall be available for review by the Contracting Officer at all times. Upon completion of the work, both sets of the marked up prints shall be certified as correct, signed by the Contractor, and delivered to the Contracting Officer for his approval before project acceptance.

1.14 NOTIFICATION OF NON-COMPLIANCE

The CO will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action. If the contractor fails or refuses to correct the non-compliant work, the CO will issue a non-compliance 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 CO may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to such stop orders the subject of claim

for extension of time, for excess costs, or damages.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 45 35

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS
08/08

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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318	(2011; Errata 2011) Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum Design Loads for Buildings and Other Structures

1.2 SYSTEM DESCRIPTION

Perform the Special Inspection for seismic-resisting system components as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.2.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Perform continuous special inspection where specified for items as shown on the drawings.

1.2.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be: at times of significant work; recurrent over the complete work period; and total at least 25 percent of the total work time. Perform periodic special inspection where specified for items as shown on the drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Special Inspector G G

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Control Plan G G

1.4 QUALITY CONTROL PLAN

Develop a quality control plan containing the following. Include a certificate indicating that the plan meets the content specified in this section with plan submittal.

a. A list of all items that require quality control Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.

b. A list of all items that require quality control testing, including the type and frequency of testing for each item on this list.

c. The content, distribution, and frequency of special inspection reports.

d. The content, distribution, and frequency of testing reports.

e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

1.5 SPECIAL INSPECTOR

Use a Special Inspector to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

Perform Special Inspections for the following where designated on the drawings:

3.1.1 Structural Steel

a. Continuous special inspection for all structural welding, except that periodic special inspection is permitted for single-pass or resistance welds and welds loaded to less than 50 percent of their design strength provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work and all welds are inspected for compliance with the approved construction documents at the completion of welding.

3.1.2 Mechanical and Electrical Components

Perform special inspection of the mechanical and electrical components ensuring that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.

b. Periodic special inspection during the installation of anchorage of all other electrical equipment.

c. Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.

d. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

3.1.3 Seismic Isolation System

Periodic special inspection during the fabrication and installation of isolator units.

3.2 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

a. Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318 and comply with all acceptance provisions contained therein.

b. Seismically Isolated Structures: Verify that the required system and component tests for seismically isolated structures have been done in accordance with ASCE 7 and comply with all acceptance provisions contained therein.

3.3 REPORTING AND COMPLIANCE PROCEDURES

a. On the first day of each month, furnish to the Government five copies of the combined progress reports of the special inspector's observations listing all special inspections of construction or reviews

of testing performed during that month, noting all uncorrected deficiencies, and describing the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies . Each monthly report shall be signed by the Contractor.

b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. Submit a combined final report containing the signed final reports of all the special inspectors. Sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
08/09

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 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 WATER WORKS ASSOCIATION (AWWA)

AWWA C511	(2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies
FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2014) National Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2000) Manual of Uniform Traffic Control Devices

1.3 SUBMITTALS

Submitted the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan; G

Traffic control plan; G

SD-06 Test Reports

Backflow Preventer Tests

SD-07 Certificates

Backflow Tester Certification

Backflow Preventers Certificate of Full Approval

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, the Contractor shall submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area onsite and offsite, and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation). Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the installer has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.5.3 Backflow Preventers

Reduced pressure principle type conforming to the applicable requirements AWWA C511. The particular make, model/design, and size of backflow preventers to be installed must be included in the latest edition of the List of Approved Backflow Prevention Assemblies issued by the FCCCHR List and be accompanied by a Certificate of Full Approval from FCCCHR List. After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof bulletin board 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. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as shown on the drawings. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. 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 will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.2 Fencing

Provide fencing along the construction site, and at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to meet or exceed OSHA requirements according to application.

2.2.3 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will 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 must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage,

shall not create unsafe conditions, and shall not violate applicable codes and standards.

3.2.1.1 Electricity

The NASA Armstrong electrical distribution system typically has 208/120 volt three phase four wire or 480/277 volt three phase four wire or 480 volt three phase three wire available for temporary power connections. Temporary electrical service to support the construction activities is available based on location and expected load from the Contractor. Contractor shall supply and install all necessary equipment for temporary service, including, but not limited to, transformers, circuit breakers, conduit, wire, boxes, receptacles, supports, safety disconnects, fuses and power cords. Should the required electrical system not be in the immediate construction vicinity, the Contractor shall make provisions for supplying their own power.

All plans for temporary electrical installations and modifications to support construction activities will be submitted for review and approval prior to connection; and such activities will be subject to NASA Armstrong Utility Outage requirements (see Section 01 35 14.11 40, paragraph "PERMIT REQUIRED OPERATIONS"). Existing electrical systems utilized by the Contractor for temporary service shall be left in a code compliant manner at the end of the construction activity.

3.2.1.2 Water

Contractor shall make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government.

3.2.1.3 Telephone Service

The Contractor shall provide telephone service for Contractor use. The Contractor shall pay costs of service. The Contractor shall coordinate with the Contracting Officer who will coordinate with NASA/AFRC telecommunications to allow system coordination for emergency 911 services.

3.2.2 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. In addition, the Contractor may also use existing sanitary facilities during the construction period.

3.2.3 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.2.4 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Provide and maintain, at Contractor's own expense, 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 the work, and the erection and maintenance of adequate warning, danger, and direction signs, as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Dust Control

The Contractor shall provide dust control in accordance with Section 01 35 14.11 40 "AFRC Safety Requirements."

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 TEMPORARY STRUCTURES

Contractor-owned or leased trailers and temporary structures, where telephone service is installed and connected to the 911 emergency system, shall be identified by Government assigned numbers. The required building number shall be displayed on the structure on signs having brilliant blue background, white numbers, and of dimensions 18 inches by 36 inches. The

signs shall be displayed on two sides of the structure at the upper left corner. The Contractor shall apply the number to the trailers within 14 days of placement, or sooner, if directed by the Government.

3.4.2 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.3 Administrative Field Offices

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.

3.4.4 Storage Area

Construct a view-obstructing temporary 6 foot high chain link fence around trailers and materials. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment 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 installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.5 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and 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 installation property.

b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.4.6 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion.

3.4.7 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own

equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.8 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.5 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.6 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stack stored materials not in trailers, whether new or salvaged.

3.7 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

07/06

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.

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

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.

ASTM INTERNATIONAL (ASTM)

ASTM E 1609	(2001) Development and Implementation of a Pollution Prevention Program

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill in support of EO 13514, Section 2 and NASA Procedural Requirements (NPR) 8530.1.

1.3 MANAGEMENT

Develop and implement a waste management program in accordance with ASTM E 1609 and as specified. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G

SD-11 Closeout Submittals

Records

Salvage Material Records shall be submitted in accordance with Paragraph "SALVAGE MATERIALS AND EQUIPMENT"

1.5 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.10 40 CONTRACTOR QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction meeting.

c. Regular on-site QC meetings.

d. Work safety meetings.

1.6 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on

the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.7 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.8 SALVAGE MATERIALS AND EQUIPMENT

All items of materials designated by the Contracting Officer to be salvaged shall remain the property of the Government. Salvage Material Records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction. Salvage items shall be marked, segregated, itemized, delivered, and off-loaded by the Contractor at the storage area near Building 4876.

The Contractor shall maintain adequate property control records for all materials or equipment designated as salvage. These records may be in

accordance with the Contractor's system of property control, if approved by the Contracting Officer. The Contractor shall be responsible for adequate storage and protection of salvaged materials and equipment and shall replace, at no cost to the Government, salvage materials and equipment broken or damaged during salvage operations.

1.9 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvageability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 35 14.11 40 AFRC SAFETY REQUIREMENTS.

Separate materials by one of the following methods:

1.9.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

   (1) Ferrous.

   (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.9.2 Commingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.9.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.10 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.10.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.10.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.10.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.10.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 75 00.00 40

AFRC STARTUP AND COMMISSIONING
10/06

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Verification of Prior Experience; G and expertise with similar project scope

Documentation of Manufacturer's Prior Experience; G and expertise with similar project materials and systems

Quality Control Plan; G including testing and start-up schedule

Manufacturer's Sample Warranty and Operation and Maintenance Data; G

Provide Evidence that products used within this specification are manufactured in the United States.

SD-02 Shop Drawings

Drawings, Diagrams and Schedules; G specifically prepared to illustrate some portion of the work

Diagrams and Instructions; G from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project

Drawings; G prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated

SD-03 Product Data

Catalog cuts; G, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work

Samples of warranty language; G when the contract requires product warranties

SD-05 Design Data

Design Calculations; G, mix designs, analyses or other data

pertaining to a part of work

SD-06 Test Reports

Factory Tests; G
Functional Field Test; G
Final Acceptance Test; G

Test Procedures; G

SD-07 Certificates

Qualification of Manufacturer; G

Qualification of Installer

Certify that the installer meets requirements specified under paragraph entitled "Qualification of Installer."

SD-08 Manufacturer's Instructions

Manufacturer's Administrative Requirements; G

Demonstration and Training Information; G

Manufacturer's Procedural Requirements; G for initial checkout, startup, and adjusting to ensure safe operation during acceptance testing and commissioning.

SD-09 Manufacturer's Field Reports

Documentation of the Testing and Verification Actions; G taken by manufacturer's representative at the job site, or on a sample taken from the job site, on a portion of the work, during installation, to confirm compliance with manufacturer's standards or instructions

SD-10 Operation and Maintenance Data

Refer to Section 01 78 23 OPERATION AND MAINTENANCE DATA for detailed requirements and procedures.

Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

Safety and Security Data or Posters provided by the manufacturer

1.2.1 Preconstruction and Pre-Testing Requirements

The Contractor is responsible to deliver equipment and services to meet the requirements and specifications of their respective contract. All equipment must be free of latent manufacturing and installation defects. Acceptance criteria must be clearly defined to establish required baselines for future maintenance and life-cycle evaluations. The Government reserves the option to elect performance of acceptance testing by internal personnel, or a designated third party. Regardless of who performs the acceptance testing, the requirements of acceptance must be met by the Contractor.

Submit the following for review and approval prior to the commencement of work and any testing, whether such testing is on site or elsewhere:

a. Verification of prior experience and expertise with similar project scope

b. Documentation of manufacturer's prior experience and expertise with similar project materials and systems

c. Quality control plan

d. Manufacturer's Sample Warranty and Operation and Maintenance Data, with details regarding start-up procedures

e. Manufacturer's administrative requirements

f. Manufacturer's procedural requirements

g. Demonstration and Training Information

Contractor must submit the following certifications:

a. Provide evidence that products used within this specification are manufactured in the United States.

b. Qualification of Manufacturer, including current licenses and insurance.

c. Qualification of Installer, including licenses and insurance.

1.2.2 Shop Drawings and Diagrams

Submit the following shop drawings, record drawings, and diagrams as required to correctly execute the installation of the work:

a. Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work

b. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project

c. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated

1.2.3 Product and Design Data

Contractor must submit all product data and any design calculations, mix designs, analyses or other data pertaining to a part of work to ensure a complete functional installation; including, but not limited to:

a. Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work

b. Samples of warranty language when the contract requiresproduct warranties

c. Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

d. Safety and Security Data or posters provided by the manufacturer to be posted in a conspicuous visible location for operational and maintenance personnel.

1.2.4 Tests Required

Perform tests to verify proper functioning of fire protection, fire suppression, HVAC, compressed air, electrical switchgear, protective relaying, fluid and gas systems, pump/motor combinations, boiler systems, hydraulic and pneumatic control, condition/performance monitoring systems, energy control and monitoring systems, and other assemblies and components that need to be tested as an interrelated whole.

1.2.4.1 STARTING OF SYSTEMS

The Contractor shall perform formal functional tests with full documentation using the approved recording form. Test procedures and recording form that document the test steps shall be submitted for approval to the Contracting Officer twenty one (21) calendar days prior to the proposed test date. The procedure shall consist of step by step instruction to verify system parameters, components, and functions.

The Contractor shall perform an "in-house" test to verify that the system and components have been properly installed and are functioning properly. Test shall be performed in the presence of the Contracting Officer. Test shall be completed and found acceptable when one full test has been performed without component or system malfunction. The contractor shall submit a Functional Test Report documenting the actual steps and results of the test.

1.2.4.2 Factory Tests

Submit certified copies of required tests performed at the factory to verify proper build. These test results will be used in the "Final Acceptance Test" section to verify no shipping damage and proper installation. Government may request to witness Factory Test prior to shipping, Contractor shall give minimum 14 calendar days advance notice to permit Government travel time.

1.2.4.3 Functional Field Test

Contractor must perform functional field test(s) to verify that the system and components have been properly installed and are functioning properly. Perform test(s) in the presence of the Contracting Officer. Acceptance will be issued when system has performed per other sections and referenced industry standards.

Coordinate and submit documentation of the testing and verification actions taken by manufacturer's representative at the job site, or on a sample taken from the job site, on a portion of the work, during installation, to confirm compliance with manufacturer's standards or instructions.

1.2.4.4 Final Acceptance Test

Perform a formal test with full documentation using the approved recording

form. Contracting Officer will witness this test and issue a written final acceptance. Provide final test data to the Contracting Officer with a cover letter clearly marked with the system name, date, and the words "Final Test Data - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

1.2.4.5 Test Procedures

Submit test procedure and recording forms that document the test steps for approval to the Contracting Officer 30 calendar days prior to the proposed test date. Procedure must clearly state step by step instruction to verify system parameters, components, and functions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
05/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	(2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

GREEN SEAL (GS)

GS-37	(2000; R 2009) Industrial and Institutional Cleaners

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Final Cleaning
Spare Parts Data

SD-08 Manufacturer's Instructions

Preventive Maintenance schedule and instructions
Condition Monitoring (Predictive Testing) schedule and instructions
Inspection schedule and instructions
Instructions to be Posted

SD-10 Operation and Maintenance Data

Equipment-in-Place List
Operation and Maintenance Manuals

SD-11 Closeout Submittals

As-Built Drawings
Certification of EPA Designated Items; G
NASA Form NF1046

1.3 PROJECT RECORD DOCUMENTS

1.3.1 As-Built Drawings

Drawings showing final as-built conditions of the project. This paragraph covers complete record drawings, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings," "as-built drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions. The red-lined drawings must consist of 2 sets of completed final as-built original drawings, and the approved deviation documentation.

1.3.1.1 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the execution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set 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 must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings 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 record (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. Show on the working and final record drawings, but not 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, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the depth below the surface of each run. In addition, a GPS survey shall be completed by Contractor when required by contract drawings.

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, show only the option selected for construction 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, 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 (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Delta at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.

(4) For minor changes, place a Modification Delta by the area changed on the drawing (each location).

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

(6) For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

(7) The Modification Delta shall be a triangle 1/2 inch in size unless the area where the delta is to be placed is crowded. Smaller size delta shall be used for crowded areas.

1.3.1.2 Drawing Preparation

Modify the record drawings as needed to correctly show the features of the project as 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 must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.3.1.3 Payment

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

1.3.2 As-Built Record of Equipment and Materials

Furnish two (2) copies of preliminary record of equipment and materials used on the project 15 days prior to final inspection, including NASA tagged collateral equipment uninstalled or removed from the site. NASA tagged collateral equipment typically has a label with a NASA logo, a

barcoded asset number, building number, and description. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit two (2) sets of final record of equipment and materials 10 days after final inspection. Key the designations to the related area depicted on the contract drawings. At a minimum, list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description, and asset tag number if available	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.3.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.5 Real Property Equipment

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

1.4 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. The Government will identify what equipment for which to provide spare parts and the number of spare parts to provide. Supply this number of items of each part for spare parts inventory as requested by the Government. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTIVE MAINTENANCE

Submit Preventive Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation

procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)." Record each product used in the project that has a requirement or option of containing recycled content in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

1.7 WARRANTY MANAGEMENT

1.7.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit two sets of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must 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 must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full

product warranty period. Include within the warranty management plan, but not 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. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

c. 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.

d. 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. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must 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.

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

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

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

1.7.2 Performance Bond

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

1.7.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, 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 will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, 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, be continuously available, and 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.

1.7.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

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_____.

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

1.8 OPERATION AND MAINTENANCE MANUALS

Submit 2 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.8.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

1.8.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer will be given 7 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the Contracting Officer.

1.9 WORK AREA CLEANUP

Provide final cleaning of contract work area in accordance with ASTM E 1971 and submit two copies of the listing of completed final clean-up items. Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

1.10 REAL PROPERTY TRANSFER DOCUMENTATION

Near the completion of Project, but not later than final transfer, complete and submit an accounting of all installed property with NASA Form NF1046 "Transfer and/or Notification of Acceptance of Accountability of Real Property."

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventive maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.1.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 4. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 4.

1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.1.4 Review and Approval

The Contractor's Commissioning Authority (CA) shall review the commissioned systems and equipment submittals for completeness and applicability. The CA shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CA shall communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA shall recommend approval and acceptance of these O&M

manuals to the Contracting Officer. This work shall be in addition to the normal review procedures for O&M data.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.2.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.2.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air

quality impacts of recommended maintenance procedures and materials.

1.2.2.1 Lubrication Data

Include preventive maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include

a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.2.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.2.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.2.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.2.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing

and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.2.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.2.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.3 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).

d. Full points list. A listing of rooms shall be provided with the following information for each room:

(1) Floor

(2) Room number

(3) Room name

(4) Air handler unit ID

(5) Reference drawing number

(6) Air terminal unit tag ID

(7) Heating and/or cooling valve tag ID

(8) Minimum cfm

(9) Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Electronic copy on disk or CD of the entire program for this facility.

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.4.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Spare parts and supply list

e. Warranty information

f. Contractor information

1.4.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

1.4.3 Data Package 3

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data

h. Preventive maintenance plan and schedule

i. Cleaning recommendations

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Product submittal data

p. O&M submittal data

q. Parts identification

r. Warranty information

s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

1.4.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Corrective maintenance man-hours

q. Product submittal data

r. O&M submittal data

s. Parts identification

t. Warranty information

u. Personnel training requirements

v. Testing equipment and special tool information

w. Testing and performance data

x. Contractor information

1.4.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. O&M submittal data

n. Parts identification

o. Warranty information

p. Testing equipment and special tool information

q. Testing and performance data

r. Contractor information

s. Manufacturer's instructions

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 86 12.07 40

RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS
02/10

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.2 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 AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

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 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

Material, Equipment, and Fixture Lists; G

SD-02 Shop Drawings

Connection Diagrams; G

Bearing Layout; G

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Manufacturer's Catalog Data; G

Equipment Foundation Data; G

Specific Equipment Data; G

Spare Parts List; G

Warranty; G

SD-05 Design Data

Design Analysis and Calculations; G

SD-06 Test Reports

Alignment Test; G

Code and Requirements Verification Test; G

Cold Starting Test; G

Ductwork Leakage Test; G

Exhaust Emissions Test; G

Hydrostatic Test; G

Noise Level Acceptance Test; G

Operational Fire Damper Test; G

Vibration Analysis Test; G

Visual Inspection; G

Warranty Test; G

SD-07 Certificates

Certificates; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals; G

SD-11 Closeout Submittals

Record Drawings; G

Acceptance Documentation; G

1.4 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed to by the project specification.

m. HVAC Ducts

1.5 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.6 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show cutaway and sectional views in gearbox fabrication drawings.

Submit data for all equipment listed in the paragraph entitled, "Product Data," of this section. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for

each specified component.

Submit bearing layout drawings detailing the type, size, and orientation of bearings for equipment containing bearings, such as motors, pumps, fans, cranes, gearboxes, etc.

Submit for all equipment listed in the paragraph entitled, "Product Data," of this section. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Submit manufacturer's catalog data and equipment foundation data for the following equipment:

m. HVAC Ducts

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

m. HVAC Ducts

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, NASA Identification number, date of installation (required or actual acceptance date), and applicable NASA reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

m. HVAC Ducts

(1) Type of duct installed

(18) Fire/gas/extinguishing system

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1 year(s) of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, piping and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function

within the HVAC system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for equipment, pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update mechanical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the Contracting Officer.

m. HVAC Ducts

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. The Government desires that all such equipment be free of latent manufacturing and installation defects, and acceptance criteria is defined to ensure, to the maximum extent possible within economic reason, that these criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words " Final Test Report Data - Forward to the Contract Officer for inclusion in the Maintenance Information Database.

g. Perform ductwork leakage test for:

(1) HVAC Ducts

m. Perform infrared thermography test for:

(4) HVAC Ducts

t. Perform operational fire damper test for:

(1) HVAC Ducts

(9) HVAC Ducts

x. Perform ultrasonic (airborne) test for:

(5) HVAC Ducts

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

m. HVAC Ducts

Submit Six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the Contracting Officer will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the Contracting Officer for processing and approval.

-- End of Section --

SECTION 01 86 26.07 40

RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS
02/12

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

This guide specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This guide specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.2 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 AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

Material, Equipment, and Fixture Lists; G

SD-02 Shop Drawings

Connection Diagrams; G

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Manufacturer's Catalog Data; G

Equipment Foundation Data; G

Specific Equipment Data; G

Spare Parts List; G

Warranty; G

SD-05 Design Data

Design Analysis and Calculations; G

SD-06 Test Reports

SF6 Gas Test; G

SF6 Gas Leakage Test; G

Air Compressor Performance Test; G

Automatic Transfer Test; G

Battery Impedance Test; G

Breaker Timing Test; G

Capacitor Bank Acceptance Test; G

Capacitor Discharge Test; G

Contact Resistance Test; G

Continuity Test; G

Fall of Potential Test; G

General Battery Test; G

General Charger Test; G

High Voltage Test; G

Infrared Thermography Test; G

Insulation Oil Test; G

Insulation Resistance Test; G

Overpotential Test; G

Point to Point Test; G

Power Factor Test; G

Turns Ratio Test; G

Ultrasonic (Airborne)Test; G

Vacuum Bottle Integrity Test; G

Visual Inspection; G

SD-07 Certificates

Certificates; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals; G

SD-11 Closeout Submittals

Acceptance Documentation; G

Record Drawings; G

Baseline Data Report; G

1.4 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed to by the project specification.

d. Breakers:

(1) General

(6) Vacuum

e. Cables:

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)

i. Electrical Automatic Transfer Switches

t. Electric Switches:

(7) Medium Voltage, Vacuum

x. Transformers

1.5 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.6 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show connection diagrams and assemblies in switchgear fabrication drawings

Submit for all equipment listed. Include manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit manufacturer's catalog data and equipment foundation data (as applicable) for the following equipment:

Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

d. Breakers:

(1) General

(6) Vacuum

e. Cables:

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)

i. Electrical Automatic Transfer Switches

(7) Medium Voltage, Vacuum

x. Transformers

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

d. Breakers:

(1) General

(6) Vacuum

e. Cables:

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)i. Electrical Automatic Transfer Switches

(7) Medium Voltage, Vacuum

x. Transformers

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, AIR FORCE Identification number, date of installation (required or actual acceptance date), and applicable AIR FORCE reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit the following specific equipment data:

e. Cables- Low, Medium, and High Voltage

(1) Power cable type

v. Transformers

(1) Transformer Type

(2) Winding resistance

(3) Current transformer ratios

(4) Transformer impedance

(5) Load loss at rated voltage and current

(6) Current loading

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 12 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1 year(s) of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, conduit and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the electrical system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for electrical equipment, panels, conduit, and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update electrical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the Contracting Officer.

t. Electric Switches:

(7) Medium voltage, vacuum

u. Electrical Transformer Load Tap Changer

x. Transformers

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. Ensure all equipment is free of latent manufacturing and installation defects, and acceptance criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor

the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection Tests

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words " Final Test Report Data - Forward to the Systems Engineer for inclusion in the Maintenance Information Database.

3.3.2 Baseline Data from Verification Testing

Upon completion of all PT&I tests submit baseline data report to the Contracting Officer. Include a summary of all performance data, set points, operating parameters and PT&I test results obtained for equipment and building systems.

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

d. Breakers:

(1) General

(6) Vacuum

(1) General

(2) Low Voltage (600V Maximum)

(3) Medium Voltage (600V-33,000V)

i. Electrical Automatic Transfer Switches

(7) Medium Voltage, Vacuum

x. Transformers

Submit six complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two copies of the document are required. Submit operations and maintenance manuals 30 calendar days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the Contracting Officer will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the Contracting Officer for processing and approval.

-- End of Section --

SECTION 02 41 00

DEMOLITION AND DECONSTRUCTION
05/10

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, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	(2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2008) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	(June 2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	(2006) MILSTRIP - Military Standard Requisitioning and Issue Procedures

MIL-STD-129	(2007; Rev P; Change 4 2007) Military Marking for Shipment and Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

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

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 PROJECT DESCRIPTION

1.2.1 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

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

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal,

deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 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.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from the Contractor.

1.3.5 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, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

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

1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the Construction Documents and Project Specifications.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G
Deconstruction Plan; G
Notification; G

SD-11 Closeout Submittals

Receipts

1.7 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.7.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building 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. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.8 PROTECTION

1.8.1 Traffic Control Signs

a. Where pedestrian, driver and aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind, jet or prop blast. Notify the Contracting Officer prior to beginning such work.

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.8.2 Protection of Personnel

Before, during and after the demolition and deconstruction work continuously evaluate the condition of the structure being demolished and deconstructed and take immediate action to protect all personnel working in and around the project 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.

1.9 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 include 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.

1.10 RELOCATIONS

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

1.11 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures.

b. Fill material shall conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

c. Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to top of foundation walls. Interior walls, other than retaining walls and partitions, shall be removed to grade or to top of concrete slab on ground. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish and Deconstruct structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish and Deconstruct concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

d. Building, or the remaining portions thereof, not exceeding 80 feet in height may be demolished by the mechanical method of demolition.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground.

3.1.4 Paving and Slabs

Sawcut concrete and asphaltic concrete paving and slabs as indicated to a depth of new finish grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Roofing

Remove existing roof system and associated components in their entirety down to existing roof deck. Remove single-ply roofing and standing seam roof panels to effect the connections with new flashing or roofing. Remove roofsurfacing from existing roofing felts for a minimum distance of 24 inches back from the cut. Cut existing membrane and/ or standing seam roof panels andinsulation along straight lines. Remove roofing system and insulation without damaging the roof deck. Sequence work to minimize building exposure between demolition or deconstruction and new roof materials installation.

3.1.5.1 Temporary Roofing

Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the Contracting Officer. The existing deck and support structure is deteriorated where indicated, such that ability to support foot traffic and construction loads is unknown. Make provisions for worker safety during demolition, deconstruction, and installation of

new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements."

3.1.5.2 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the Contracting Officer. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

3.1.6 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as specified for the new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations. Masonry removed in whole blocks shall be salvaged and stored for reuse. Masonry removed in pieces shall be crushed for use as aggregate.

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for reuse and recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.10 Carpentry

Salvage for recycle lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood. Salvage windows, doors, frames,

and cabinets, and similar items as whole units, complete with trim and accessories. Salvage hardware attached to units for reuse. Brace the open end of door frames to prevent damage.

3.1.11 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.12 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles and support grid for re-installation. New ceiling tiles and support grid system shall be installed (to match exisitng)where damaged recycled tiles and grid cannot be reused.

3.1.13 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, using on-site materials when available. 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. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, 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.

3.1.14 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.15 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of

in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.16 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

3.1.17 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.17.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.17.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.17.3 Ducts

Classify removed duct work as scrap metal.

3.1.17.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or

otherwise unserviceable as debris to be disposed of by the Contractor.

3.1.18 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.18.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.18.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.18.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.18.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.19 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition and Deconstruction Plan to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition and Deconstruction Plan indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site as directed.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.

c. Remove salvaged items to remain the property of the Government 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 must be repaired or replaced to match existing items. Properly identify the contents of containers.

d. Remove items reserved as property of the using service prior to commencement of work under this contract.

e. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, as directed by the Commanding.

3.3.4 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 AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer. 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.

Submit Receipts or bills of lading, as specified.

3.3.4 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

3.3.5 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.6 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.7 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located. Dispose of unsalvageable and non-recyclable combustible material off the site.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified Storage of removed materials on the project site is prohibited.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property. Control fires for protection of persons and property. Monitor fires continuously until the fires have burned out or have been extinguished.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 02 83 13.00 20

LEAD IN CONSTRUCTION
08/11

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 INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6	(2006) Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

STATE OF VIRGINIA ADMINISTRATIVE CODE (VAC)

16 VAC 25-35	Title 16, Agency 25, Chapter 35: Regulation Concerning Certified Lead Contractor's Notification, Lead Project Permits And Permit Fees
18 VAC 15-30	Title 18, Agency 15, Chapter 30: Virginia Lead-Based Paint Activities Regulations

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	(1995; Errata Aug 1996;Rev Ch. 7 - 1997) Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

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

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
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 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.2.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.4 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.6 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.7 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.2.8 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.9 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.10 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.11 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.12 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

1.3 DESCRIPTION

1.3.1 Description of Work

Construction activities impacting PWL or material containing lead which are covered by this specification include the demolition and/or removal of material containing lead may be located on the existing painted steel structural supports members located throughout all of the hangars. Lead may be encountered through activities such as: sanding, welding, cutting/removal of exisitng steel members, addition of new steel support members, sytems supporting the new draft curtains, and intake/exhaust venting hoods for the high expansion foam generator system.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if objective data is used to justify excluding the initial occupational exposure assessment); G

Lead Compliance Plan including CP approval (signature, date, and certification number); G

Competent Person qualifications; G

Training Certification of workers and supervisors; G

lead waste management plan; G

written evidence that TSD is approved for lead disposal; G

Certification of Medical Examinations; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Testing laboratory qualifications; G

Occupant Notification; G

Third party consultant qualifications; G

Clearance Certification; G

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility; G

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and licensed and certified in accordance with federal, State (18 VAC 15-30) and local laws. The competent person shall be a licensed lead-based paint abatement Supervisor/Project Designer in the State of California.

1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the accredited training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62(l)and is certified to perform or supervise deleading, lead removal or demolition activities in the state of California.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe analysis, testing, and reporting of airborne concentrations of lead. Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained

and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.

c. Continuously inspect PWL or MCL work for conformance with the approved plan.

d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Control work to prevent hazardous exposure to human beings and to the environment at all times.

g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.

h. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of PWL or MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

The plan shall be developed by a certified planner/project designer in the State of California.

In occupied buildings, the plan shall also include an occupant protection program that describes the measures that will be taken during the work to

notify and protect the building occupants.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.5.2.5 Training

Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State (18 VAC 15-30) and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by AIHA Z88.6, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations. and address:

a. Identification and classification of wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of State (in accordance with 16 VAC 25-35)and local hazardous wastepermitsandUSEPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.

h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.

i. Unit cost for hazardous waste disposal according to this plan.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following local and State laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

a. Las Angeles County

b. Kern County

c. Armstrong Flight Research Center

Licensing and certification in the state of California is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any lead work.

b. Occupant Notification

Submit occupant written acknowledgment of the delivery of lead hazard information pamphlet (EPA 747-K-99-001 "Protect Your Family From Lead in Your Home") prior to commencing the renovation work for each affected unit using language provided in 40 CFR 745 Subpart E.

3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

The Contractor shall remove furniture and equipment from the building before lead work begins.

Furniture and equipment will remain in the lead control area. Protect and cover furnishings or remove furnishings from the work area and store in a location approved by the Contracting Officer.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in

accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.7 Mechanical Ventilation System

a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.

c. Use locally exhausted, power actuated tools or manual hand tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed.

Full containment - Contain removal operations by the use of critical barriersa negative pressure enclosure system with decontamination facilities and with HEPA filtered exhaust if required by the CP. For containment areas larger than 1,000 square feet install a minimum of two 18 inch square viewing ports. Locate ports to provide a view of the required work from the exterior of the enclosed contaminated area. Glaze ports with laminated safety glass.

3.3 APPLICATION

3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62 or 40 CFR 745, and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods.

The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual removal and thermal cutting in the lead control areas using enclosures, barriers or containments and powered locally exhausted tools. Collect residue for disposal in accordance with federal, State, and local requirements.

3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) shall be job dependent and presented in the Lead Compliance Plan.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn in the control area:

a. Vacuum all clothing before entering the contaminated change room.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Shower.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.

d. Change to clean clothes prior to leaving the clean clothes storage area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and wipe sampling and inspecting the PWL or MCL removal work to ensure that the requirements of the contract have been satisfied during the entire PWL or MCL operation.

b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or

a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken.

d. Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval.

e. Before any work begins, a third party consultant shall collect and analyze baseline wipe samples in accordance with methods defined by federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead disturbance or removal.

f. Surface Wipe Samples - Collect surface wipe samples on floors at a location no greater than 10 feet outside the lead control area at a frequency of once per day while lead removal work is conducted in occupied buildings. Surface wipe results shall meet criteria in paragraph "Clearance Certification.

3.4.1.2 Sampling After Removal

After the visual inspection, collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust in micrograms per square meter foot of surface area .

3.4.1.3 Testing of Material Containing Lead Residue

Test residue in accordance with 40 CFR 261 for hazardous waste.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

The third party consultant shall certify surface wipe sample results collected inside and outside the work area are less than 40 micrograms per square foot on floors, less than 250 micrograms per square foot on interior window sills and less than 400 micrograms per square foot on window troughs not significantly greater than the initial surface loading determinedprior to work.

The third party consultant shall certify surface wipe sample results collected inside and outside the work area are less than 200 micrograms per square foot on floors or horizontal surfaces.

Certify surface wipe samples are not significantly greater than the initial surface loading determined prior to work.

Clear the lead control area in industrial facilities of all visible dust and debris.

For exterior work, soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the operation. If soil lead levels either show a statistically significant increase above soil lead levels prior to work or soil lead levels above any applicable federal or state standard for lead in soil, the soil shall be remediated.

3.5.2 Disposal

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261.

c. Dispose of lead-contaminated material classified as hazardous waste at an EPAorState approved hazardous waste treatment, storage, or disposal facility off Government property.

d. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The

Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

e. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility. Provide turn-in documents or weight tickets for non-hazardous waste disposal.

3.5.2.2 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

-- End of Section --

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE
04/08

PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance with ACI MCP SET Parts 2 and 3.

1.2 UNIT PRICES

1.2.1 Concrete Payment

Payment will cover all costs associated withmanufacturing, furnishing, delivering, placing, finishing, and curing of concrete for the various items of the schedule, including the cost of all formwork. Payment for concrete, for which payment is made as a lump sum, is not 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.

1.2.2 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 metal 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.

1.2.3 Unit of Measure

Unit of measure: cubic yard.

1.3 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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI MCP SET	(2013) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2012) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2012) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2013a) Standard Specification for Ready-Mixed Concrete

ASTM C989/C989M	(2012a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM D98	(2005) Calcium Chloride
ASTM E96/E96M	(2012) Standard Test Methods for Water Vapor Transmission of Materials
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.4 SYSTEM DESCRIPTION

The Government retains the option to sample and test joint sealer, joint filler material, waterstop, aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with ASTM D75/D75M. Sample concrete in accordance with ASTM C172/C172M. Determine slump and air content in accordance with ASTM C143/C143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C31/C31M. Test compression test specimens in accordance with ASTM C39/C39M. Take samples for strength tests not less than once each shift in which concrete is produced from each class of concrete required. Provide a minimum of three specimens from each sample; two to 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 are the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete is 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

Apply a Class "C" finish to all surfaces except those specified to receive

a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces which will be permanently concealed. Surface requirements for the classes of finish required are as specified in Part 4 of ACI MCP SET.

1.4.3 Concrete Mixture Proportions

Concrete mixture proportions are 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. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be as indicated on the sructural drawings at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate is 1-1/2 inch, in accordance with ACI MCP SET Part 3. The air content shall be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water cement ratio is 0.50. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

1.5 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings G

SD-03 Product Data

Air-Entraining Admixture
Accelerating Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Expansion Joint Filler Strips, Premolded
Joint Sealants - Field Molded Sealants

Batching and Mixing Equipment
Conveying and Placing Concrete
Formwork
Forms
Ready-Mix Concrete
Mix Design Data G
Air-Entraining Admixtures
Fly Ash
Accessories
Curing Compound

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions

Compressive Strength Testing G

Slump

SD-07 Certificates

Cementitious Materials
CPG for recycled materials or appropriate Waiver Form
Aggregates
Bill of Lading

1.6 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement, Forms, Steel Reinforcement, Accessories, Expansion Joints, Construction Joints, Contraction Joints Control Joints on installation drawings and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

1.6.1 Regulatory Requirements

The state statutory and regulatory requirements: form a part of this specification to the extent referenced. Submit CPG for recycled materials or appropriate Waiver Form.

PART 2 PRODUCTS

2.1 MATERIALS

Submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the specified materials.

2.1.1 Cementitious Materials

Submit Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with 40 CFR 247. Provide cementitious materials that conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C150/C150M, Type II or V, low alkali.

2.1.1.2 Pozzolan

Provide pozzolan that conforms to ASTM C618, Class C or F, including requirements of Tables 1A and 2A.

2.1.2 Aggregates

Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C33/C33M Class Designations 4M or better or state highway department specification in accordance with paragraph REGULATORY REQUIREMENTS "be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. Perform evaluation of fine and coarse aggregates separately and in combination, matching the proposed mix design

proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.08 percent at 16 days after casting. If the test data indicates an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1260 and ASTM C1567. Perform the additional testing using ASTM C1260 and ASTM C1567 using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. Use GGBF slag in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 15 to 25
percent of the total cementitious material by mass". Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260/C260M.

2.1.3.2 Accelerating Admixture

Provide calcium chloride meeting the requirements of ASTM D98. Other accelerators shall meet the requirements of ASTM C494/C494M, Type C or E.

2.1.3.3 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C494/C494M, Type A, B, or D. High-range water reducing admixture Type F or G may be used only when approved, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

2.1.4 Water

Use fresh, clean, potable water for mixing and curing, 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

Provide reinforcing bars conforming to the requirements of ASTM A615/A615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A185/A185M. Details of reinforcement not shown shall be in accordance with ACI MCP SET Part 3, Chapters 7 and 12.

2.1.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D1752, Type I.

2.1.7 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to ASTM C920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to 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, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.1.8 Formwork

The design and engineering of the formwork as well as its construction, will be the responsibility of the Contractor. Submit formwork design prior to the first concrete placement.

2.1.9 Form Coatings

Coat forms, for exposed surfaces, with a nonstaining form oil to be applied shortly before concrete is placed.

2.1.10 Vapor Barrier

Provide polyethylene vapor barrier 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 E96/E96M.

2.1.11 Curing Materials

Provide curing materials conforming to the following requirements.

2.1.11.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C171, type optional, except polyethylene film, if used, shall be white opaque.

2.1.11.2 Membrane-Forming Curing Compound

ASTM C309, Type 1-D or 2, Class A.

2.2 READY-MIX CONCRETE

a. Concrete shall be ready-mix concrete with mix design data conforming to ACI MCP SET Part 2. Bill of Lading for each ready-mix concrete delivery shall be in accordance with ASTM C94/C94M.

b. Non-exposed concrete elements: 3000 psi minimum compressive strength.

c. Direct-exposed concrete elements (including air-conditioned rooms): 5000 psi minimum compressive strength as determined in 28 calendar days.

d. Slump: 1 to 4 inch according to ASTM C143/C143M and ACI MCP SET Part 1.

e. Portland Cement conforming to ASTM C150/C150M, Type II.

f. Use one brand and type of cement for formed concrete having

exposed-to-view finished surfaces.

g. Air-Entraining Admixtures conforming to ASTM C260/C260M. Exterior concrete exposed to freezing needs to be air-entrained 5 to 6 percent by volume. Nonair-entrained interior concrete shall have a total air content of 2 to 4 percent by volume.

h. Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C494/C494M.

i. Fly Ash used as an supplementary cementitious material shall conform to ASTM C618, Class F with 4 percent maximum loss on ignition and 25 percent maximum cement replacement by weight. Submit documentation in compliance with 40 CFR 247.

j. Ground granulated blast furnace slag used as an supplementary cementitious material shall conform to ASTM C989/C989M, Grade 120 with between 25 to 50 percent maximum cement replacement by weight. Submit documentation in compliance with 40 CFR 247.

2.3 STEEL REINFORCEMENT

2.3.1 Deformed Steel Bars

Provide steel bars conforming to ASTM A615/A615M, Grade 60 ksi ACI MCP SET Parts 2 and 3.

2.3.2 Welded Wire Fabric

Provide welded wire fabric conforming to ASTM A185/A185M.

2.4 FORMS

Forms shall be of wood, steel, or other approved material and conform to ACI MCP SET, Parts 2 and 3.

Provide form release conforming to ACI MCP SET, Part 4.

2.5 ACCESSORIES

2.5.1 Curing Compound

Provide curing compound conforming to ASTM C309.

PART 3 EXECUTION

3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface shall be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Earth foundations shall be satisfactorily compacted. Ensure spare vibrators are available. The entire preparation shall be accepted by the Government prior to placing.

3.1.1 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is 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 is 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.

3.1.2 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges , unless otherwise indicated.

3.1.3 Vapor Barrier Installation

Apply vapor barriers over gravel fill. Lap edges not less than 6 inches. Seal all joints with pressure-sensitive adhesive not less than 2 inches wide. Protect the vapor barrier at all times to prevent injury or displacement prior to and during concrete placement.

3.1.4 Production of Concrete

3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C94/C94M except as otherwise specified.

3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C685/C685M.

3.1.4.3 Batching and Mixing Equipment

The Contractor has 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. Submit the method of measuring materials, batching operation, and mixer for review, and manufacturer's data for batching and mixing equipment demonstrating compliance with the applicable specifications.. Provide an Onsite Plant conforming to the requirements of either ASTM C94/C94M or ASTM C685/C685M.

3.2 CONVEYING AND PLACING CONCRETE

Concrete placement is not permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, deliver the concrete to the site of the work completing the discharge within 1-1/2 hours or 45 minutes when the placing temperature is 86 degrees F or greater unless a retarding admixture is used. Convey concrete 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. Deposit concrete as close as possible to its

final position in the forms and regulate it so that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. Carry on the placement at such a rate that the formation of cold joints will be prevented. Submit Methods and equipment for transporting, handling, depositing, and consolidating the concrete prior to the first concrete placement. Perform conveying and placing concrete in conformance with the following:

3.2.1 Consolidation

Consolidate each layer of concrete by rodding, spading, orinternal vibrating equipment. Systematically accomplish internal vibration 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 approximately 4 inches. Ensure that the vibrator penetrates rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. Hold vibrator stationary until the concrete is consolidated and then withdraw it slowly at the rate of about 3 inches per second.

3.2.2 Cold-Weather Requirements

No concrete is to be mixed or placed when the ambient temperature is below 36 degrees F or if the ambient temperature is below 41 degrees F and falling. Provide suitable covering and other means as approved 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. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing. Remove and replace concrete damaged by freezing at the expense of the Contractor.

3.2.3 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI MCP SET Part 2, is expected to exceed 0.2 psf 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 taken as quickly as finishing operations will allow.

3.2.4 Lifts in Concrete

Deposit concrete in horizontal layers not to exceed 24 inches in thickness. Carry on placement at a rate that prevents the formation of cold joints. Place slabs in one lift.

3.3 FORM REMOVAL

Do not remove forms before 24 hours after concrete placement, except as otherwise specifically authorized. Do not remove supporting forms and shoring until the concrete has cured for at least 5 days. When conditions require longer curing periods, forms shall remain in place.

3.4 FINISHING

3.4.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

Remove all fins and loose materials , and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete 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. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling 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 is the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

Float finish all unformed surfaces, that are not to be covered by additional concrete or backfill, 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. Slope exterior surfaces for drainage unless otherwise shown. Carefully make joints with a jointing tool. Finish unformed surfaces to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish as determined by a 10 foot straightedge placed on surfaces shown on the drawings to be level or having a constant slope. Do not perform finishing while there is excess moisture or bleeding water on the surface. No water or cement is to be added to the surface during finishing.

3.4.3.1 Float Finish

Provide float finished surfaces, 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 supports a person's weight without deep imprint, complete floating. Floating shall 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

Apply a trowel finish to where indicated on the architectural drawings.. Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Protect finished surfaces from damage during the construction period.

3.4.3.3 Broom Finish

Apply a broom finish as indicated on the structural drawings. Screed and float the concrete to required finish plane with no coarse aggregate visible. After surface moisture disappears, broom or brush the surface 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

Make expansion and contraction joints 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. Provide expansion joints at a maximum spacing of 30 feet on center in sidewalks , unless otherwise indicated. Provide contraction joints at a maximum spacing of 6 linear feet in sidewalks , unless otherwise indicated. Cut contraction joints 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, cure and protect all concrete from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. Provide all materials and equipment needed for adequate curing and protection at the site of the placement prior to the start of concrete placement. Accomplish moisture preservation of moisture for concrete surfaces not in contact with forms 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 C171.

e. Application of membrane-forming curing compound conforming to ASTM C309, Type 1-D, on surfaces permanently exposed to view. Accomplish Type 2 on other surfaces in accordance with manufacturer's instructions.

Accomplish the preservation of moisture for concrete surfaces placed against wooden forms by keeping the forms continuously wet for 7 days , except for concrete made with Type III cement, for 3 days. If forms are removed prior to end of the required curing period, use other curing methods for the balance of the curing period. Do not perform protection removal if the temperature of the air in contact with the concrete may drop more than 60 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 Field Testing Technicians

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

Inspect foundation or construction joints, forms, and embedded items 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

Check air content at least once during each shift that concrete is placed

for each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C231/C231M.

3.6.2.3 Slump

Check slump once during each shift that concrete is producedfor each class of concrete required. Obtain samples in accordance with ASTM C172/C172M and tested in accordance with ASTM C143/C143M.

3.6.2.4 Consolidation and Protection

Ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.3 Action Required

3.6.3.1 Placing

Do not permit placing to begin until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Do not continue placing if any pile is inadequately consolidated.

3.6.3.2 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3.6.3.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete to the forms. 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

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within 3 days after the end of each weekly reporting period.

3.7 FORM WORK

Form work shall conform to ACI MCP SET Parts 2 through 5.

3.7.1 Preparation of Form Surfaces

Forms shall be true to line and grade, mortar-tight, and sufficiently rigid to prevent objectionable deformation under load. Form surfaces for permanently exposed faces shall be smooth, free from irregularities, dents, sags, or holes. Chamfer exposed joints and exposed edges. Arrange internal ties so that when the forms are removed, the form ties are not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structure.

3.7.2 Form Coating

Coat forms, for exposed surfaces, with a nonstaining form release coating applied shortly before concrete is placed. before the steel case is added to avoid contaminating the reinforcing steel. Forms for unexposed surfaces may be wetted in lieu of coating immediately before the placing of concrete, except that in freezing weather form release coating shall be used.

3.7.3 Removal of Forms

Remove forms carefully to prevent damage to the concrete. Do not remove forms before the expiration of the minimum time indicated below:

Arches, beams and deck-type slabs	144 hours
Columns and walls (lifts 15 feet and under)	24 hours
Columns and walls (lifts over 15 feet)	48 hours

3.8 STEEL REINFORCING

Reinforcement shall be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.8.1 Fabrication

Shop fabricate steel reinforcement in accordance with ACI MCP SET Parts 2 and 3. Shop details and bending shall be in accordance with ACI MCP SET Parts 2 and 3.

3.8.2 Splicing

Perform splices in accordance with ACI MCP SET Parts 2 and 3.

3.8.3 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.9 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.10 FIELD TESTING

a. Provide samples and test concrete for quality control during placement. Sampling of fresh concrete for testing shall be in accordance with ASTM C172/C172M.

b. Test concrete for compressive strength at 7 and 28 days for each design mix. Concrete test specimens shall conform to ASTM C31/C31M. Perform Compressive strength testing conforming to ASTM C39/C39M.

c. Test Slump at the plant site of discharge for each design mix in accordance with ASTM C143/C143M.

d. Test air content for air-entrained concrete in accordance with ASTM C231/C231M. Test concrete using lightweight or extremely porous aggregates in accordance with ASTM C173/C173M.

e. Determine temperature of concrete at time of placement.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
05/10

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3	(2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2012) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2010) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C1513	(2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2010) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

angles and plates

1.3 QUALIFICATION OF WELDERS

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

1.4 DELIVERY, STORAGE, AND PROTECTION

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

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish

as the metal to which applied.

2.1.5.1 Expansion Anchors and/or Adhesive Anchors

Provide expansion anchors as shown on the structural drawings . Diameter and Minimum concrete embedment shall beas indicated on the structural drawings. Adhesive anchors shall meet the criteria of ACI 308. The bond strength of 1/2" dia. grade 60 rebar shall be 995 psi minimum. The ultimate strength for 1/2" rebar shall be 18000 lb. minimum. Design values listed shall be as tested according to ASTM E488/E488M.

2.1.5.2 Lag Screws and Bolts

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

2.1.5.3 Toggle Bolts

ASME B18.2.1.

2.1.5.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.5.5 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.5.6 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.5.7 Washers

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

2.1.5.8 Theaded Rods

ASTM A193/A193M and ASTM A307 Rod stiffeners shall compy with ASTM A307

2.1.6 Slotted Channel Framing

Cold-formed metal channels 1-5/8" by 1-5/8" (1-5/8" by 3-1/4" double) with flange edges returned toward web. Channels made from galvanized steel complying with ASTM A653/A653M structural quality grade 33 with G90 coating.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

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

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

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

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3 MISCELLANEOUS PLATES AND SHAPES

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

Provide angles and plates, ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A123/A123M.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

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

3.5 WELDING

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

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat

conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

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

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY
02/12

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 HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(2010) American Softwood Lumber Standard

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

AREMA Eng Man	(2012) Manual for Railway Engineering

AMERICAN WOOD COUNCIL (AWC)

AWC NDS	(2012) National Design Specification (NDS) for Wood Construction
AWC WFCM	(2012) Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA M2	(2011) Standard for Inspection of Treated Wood Products
AWPA M6	(2013) Brands Used on Preservative Treated Materials

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445	(2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA F405	(1999) Performance Rated Panels
APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood
APA S350	(2011) Performance Standard for Wood-Based Structural-Use Panels

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.5.2.1M	(2006; R 2011) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2010) Metric Round Head Square Neck Bolts
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1136	(2012) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1396/C1396M	(2013) Standard Specification for Gypsum Board
ASTM D3498	(2003; R 2011) Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
ASTM E96/E96M	(2012) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F547	(2006; R 2012) Nails for Use with Wood and Wood-Base Materials

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	(2009) Particleboard

FM GLOBAL (FM)

FM 4435	(2013) Roof Perimeter Flashing

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2012) International Building Code

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2011) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2013) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use	(1998) Redwood Lumber Grades and Uses

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec	(1986; Supple. No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS56	(1973) Structural Glued Laminated Timber
DOC/NIST PS58	(1973) Basic Hardboard (ANSI A135.4)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923	(Rev A; Notice 2) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 2) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 2) Shield Expansion (Nail Anchors)
FS UU-B-790	(Rev A; Am 1; Notice 1) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(2004) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5	(2011) Western Lumber Grading Rules

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Oriented Strand Board
Adhesives

SD-06 Test Reports

Preservative-treated lumber and plywood

SD-07 Certificates

Certificates of grade

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Preservative treatment

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870.Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.4.3 Preservative-Treated Lumber and Plywood

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.4 Hardboard, Gypsum Board, and Fiberboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and board, 19 percent maximum

b. Timbers 5 inches and thicker, 25 percent maximum

c. Materials other than lumber; moisture content shall be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

Treat

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Brush coat areas

that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. All lumber and woodwork shall be preservative treated. Plastic lumber shall not be preservative treated. The following items shall be preservative treated:

1. Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.

2. Wood members that are in contact with water.

3. Exterior wood steps, platforms, and railings; and all wood framing of open, roofed structures.

4. Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

5. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.8 QUALITY ASSURANCE

1.8.1 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

PART 2 PRODUCTS

2.1 LUMBER

2.1.1 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed. Finger-jointed lumber may be used in the same applications as solid lumber of an equivalent species and grade, provided the finger-jointed lumber meets all the requirements of the certification and the quality control programs of the rules writing agency having jurisdiction and all applicable requirements of DOC/NIST PS56.

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber
WWPA G-5 standard grading rules	Aspen, Douglas Fir-Larch, Douglas Fir South, Engelmann Spruce-Lodgepole Pine, Engelmann Spruce, Hem-Fir, Idaho White Pine, Lodgepole Pine, Mountain Hemlock, Mountain Hemlock-Hem-Fir, Ponderosa Pine-Sugar Pine, Ponderosa Pine-Lodgepole Pine, Subalpine Fir, White Woods, Western Woods, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common
WCLIB 17 standard grading rules	Douglas Fir-Larch, Hem-Fir, Mountain Hemlock, Sitka Spruce, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber
SPIB 1003 standard grading rules	Southern Pine	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
SCMA Spec standard specifications	Cypress	No. 2 Common	No. 2 Common
NELMA Grading Rules standard grading rules	Balsam Fir, Eastern Hemlock-Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine-Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common except Standard for Eastern White and Northern Pine
RIS Grade Use standard specifications	Redwood	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	Construction Heart

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber
NHLA Rules rules for the measurement and inspection of hardwood and cypress lumber	Cypress	No. 2 Dimension	No. 2 Common

2.2 PLYWOOD, AND ORIENTED STRAND BOARD (OSB) PANELS

APA L870, APA S350, APA E445, and APA F405 respectively.

2.2.1 Subflooring

2.2.1.1 Plywood

C-D Grade, Exposure 1 durability classification, Span rating of 48/24 or greater.

2.2.1.2 and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 48/24 or greater. OSB, APA E445, Rated Sturd-I-Floor.

2.2.2 Combination Subfloor-Underlayment

2.2.2.1 Plywood

Underlayment Grade, Exposure 1. Minimum thickness shall be as listed below except where indicated to have greater thickness.

Support Spacing	Underlayment Minimum Thickness
16 inches	1/2 inch for Group 1 species
	19/32 inch for Group 2 and 3 species
	23/32 inch for Group 4 species
24 inches	23/32 inch for Group 1 species
	7/8 inch for Group 2 and 3 species
	1 inch for Group 4 species

2.2.3 Wall Sheathing

2.2.3.1 Plywood

C-D Grade, Exposure 1, and a minimum thickness of 1/2 inch , except where indicated to have greater thickness. Provide exterior grade particleboard with phenol resin for interior and exterior applications.

2.2.3.2 and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 24/0 or greater. OSB, APA Rated Sheathing. OSB shall be a phenolic-glued, low-formaldehyde board.

2.2.4 Roof Sheathing

2.2.4.1 Plywood

C-D Grade, Exposure 1, with an Identification Index of not less than 24/0 Provide exterior grade particleboard with phenol resin for interior and exterior applications.

2.2.5 Other Uses

2.2.5.1 Plywood

Plywood for backing.

2.2.5.2 OSB Panels

OSB panels for backing.

2.3 UNDERLAYMENT

Underlayment shall conform to one of the following:

2.3.1 Hardboard

AHA A135.4 service class, sanded one side, 1/4 inch thick, 4 feet wide.

2.3.2 Particleboard

CPA A208.1, Grade 1-M-1, 1/4 inch thick, 4 by 4 feet. Compressed fibers with phenol formaldehyde resin binder.

2.3.3 Plywood

Plywood shall conform to APA L870, underlayment grade with exterior glue, or C-C (Plugged) exterior grade 11/32 inch thick, 4 feet wide.

2.3.4 Oriented Strand Board

OSB underlayment grade 0.225 inch.

2.4 OTHER MATERIALS

2.4.1 Hardboard Underlayment

DOC/NIST PS58, service class, sanded on one side, 1/4 inch thick 4 feet

wide.

2.4.2 Gypsum Wall Sheathing

ASTM C1396/C1396M, 1/2 inch thick fire retardant (Type X) 5/8 inch thick; 4 feet wide with square edge for supports 16 inches o.c. with or without corner bracing of framing orfor supports 24 inches o.c. with corner bracing of framing; 2 feet wide with V-tongue and groove (T&G) edge for supports 16 or 24 inches o.c. with corner bracing of framing.

2.4.3 Building Paper

FS UU-B-790, Type I, Grade D, Style 1.

2.4.4 Roof Decking

Roof decking shall be commercial select grade with minimum design value of 1100 psi in bending. Decking shall be 2 inches thick with single tongue and groove

2.4.5 Miscellaneous Wood Members

2.4.5.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size inch
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4.
Furring	1 x 2
Grounds	Plaster thickness by 38.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.4.5.2 Wood Bumpers

AREMA Eng Man, Industrial grade cross ties

2.4.5.3 Sill Plates

Sill plates shall be standard or number 2 grade.

2.4.5.4 Blocking

Blocking shall be standard or number 2 grade.

2.4.5.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

2.4.6 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit.

2.5 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Fasteners may contain post-consumer or post-industrial recycled content. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be hot-dip zinc-coated in accordance with ASTM A153/A153M. Nails and fastenings for fire-retardant treated lumber and woodwork exposed to the weather shall be copper alloy or hot-dipped galvanized fasteners as recommended by the treated wood manufacturer.

2.5.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.5.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.5.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 3/8 inch.

2.5.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.5.5 Wood Screws

ASME B18.6.1.

2.5.6 Nails

ASTM F547, size and type best suited for purpose. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be hot-dipped galvanized in accordance with ASTM A153/A153M. Nailing shall be in accordance with the recommended nailing schedule contained in AWC WFCM. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail

capacity tables in AWC NDS. Reasonable judgment backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.5.7 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.5.8 Tie Straps

For joists supported by the lower flange of steel beams, provide 1/8 by 1-1/2 inch steel strap, 2 feet long , except as indicated otherwise.

2.5.9 Door Buck Anchors

Metal anchors, 1/8 by 1-1/4 inch steel, 12 inches long, with ends bent 2 inches , except as indicated otherwise. Anchors shall be screwed to the backs of bucks and built into masonry or concrete. Locate 8 inches above sills and below heads and not more than 24 inches intermediately between. Anchorage of bucks to steel framing shall be as indicated.

2.5.10 Metal Bridging

Where not indicated or specified otherwise, No. 16 U.S. Standard gage, cadmium-plated or zinc-coated.

2.5.11 Beam Anchors

Steel U-shaped strap anchors 1/4 inch thick by 1-1/2 inches wide, except as indicated otherwise.

2.5.12 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated steel conforming to ASTM A653/A653M, G90. Except where otherwise shown, Steel shall be not lighter than 18 gage. Special nails supplied by the manufacturer shall be used for all nailing.

2.5.13 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

2.6 AIR INFILTRATION BARRIER

Air infiltration barrier shall be building paper meeting the requirements of ASTM C1136, Type IV, style optional or a tear and puncture resistant olefin building wrap (polyethylene or polypropylene) with a moisture vapor transmission rate of 125 g per square meter per 24 hours in accordance with ASTM E96/E96M, Desiccant Method at 23 degrees C or with a moisture vapor transmission rate of 670 g per square meter per 24 hours in accordance with ASTM E96/E96M, Water Method at 23 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AWC WFCM unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.1.1 Bridging

Provide bridging for floor and ceiling joists and for roof rafters having slopes of less than 1/3. Locate bridging as indicated and as specified herein. Provide bridging for spans greater than 6 feet, but do not exceed 8 feet maximum spacing between rows of bridging. Install rows of bridging uniformly. Provide metal or wood cross-bridging, except where solid bridging is indicated. Do not nail the bottom end of cross-bridging until the subfloor has been laid.

3.1.1.1 Wood Cross-Bridging

Provide wood cross-bridging not less than 1 by 3 nominal size. Nail wood cross-bridging at each end with two 8-penny nails for one by thick material andthree 8-penny nails for 2 by thick material.

3.1.1.2 Metal Cross-Bridging

Shall be the manufacturer's standard product, not less than 16 gage before forming and coating. Metal bridging shall be the compression type, lodged into or nailed to the wide faces of opposite joists at points diagonally across from each other near the bottoms and tops of joists.

3.1.2 Subflooring

3.1.2.1 Plywood, and OSB Panels

Apply best side up with the grain of outer plies or the long dimension at right angles to joists. Stagger end joints and locate over the centerline of joists. Support panel edges by nominal 2 by 4 members framed between joists so the edge joints of subfloor occur over the centerline of blocking. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Panels

shall be continuous over two or more spans. Nail panels 6 inches o.c. at supported edges and 10 inches o.c. over intermediate bearing. Nails shall be 8-penny common or 6-penny threaded. Provide at least 1/2 inch clearance between subflooring and masonry or concrete walls. Subflooring may be installed with adhesive conforming to ASTM D3498 and nails spaced at 12 inches on center unless otherwise shown.

3.1.2.2 Wood

Subflooring shall be applied diagonally with end joints made over supports. Each board shall bear on at least three supports and shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width.

3.1.3 Underlayment

Install underlayment over subfloor just prior to laying of resilient flooring and protect from water and physical damage. Underlayment shall be hardboard or particleboard orplywood or OSB. Stagger end joints of underlayment with respect to each other, and stagger all joints with respect to paralleling panel joints in subfloor. Space panels 1/16 inch apart at ends and 1/8 inch apart at edges and at least 1/2 inch from concrete or masonry walls. Nail panels 6 inches o.c. along edges and 6 inches o.c. each way throughout panel, but not closer than 3/8 inch to panel edges. Nails shall be 4-penny annular ring or screw type and shall be countersunk 1/16 inch. Lightly sand all joints to receive resilient flooring.

3.1.4 Wall Framing

3.1.4.1 Studs

Select studs for straightness and set plumb, true, and in alignment. In walls and partitions more than eight feet tall, provide horizontal bridging at not more than 8 feet o.c. using nominal 2 inch material of the same width as the studs; install the bridging flat. Sizes and spacing of studs shall be as indicated. Double studs at jambs and heads of openings and triple at corners to form corner posts. Frame corner posts to receive sheathing, lath, and interior finish. Truss over openings exceeding 4 feet in width or use a header of sufficient depth. Toe-nail studs to sills or sole plates with four 8-penny nails or fasten with metal nailing clips or connectors. Anchor studs abutting concrete or masonry walls thereto near the top and bottom and at midheight of each story using expansion bolts or powder-actuated drive studs.

3.1.4.2 Plates

Use plates for walls and partitions of the same width as the studs to form continuous horizontal ties. Splice single plates; stagger the ends of double plates. Double top plates in walls and bearing partitions, built up of two nominal 2 inch thick members. Top plates for nonbearing partitions shall be single or double plates of the same size as the studs. Nail lower members of double top plates and single top plates to each stud and corner post with two 16-penny nails. Nail the upper members of double plates to the lower members with 10-penny nails, two near each end, and stagger 16 inches o.c. intermediately between. Nail sole plates on wood construction through the subfloor to each joist and header; stagger nails. Anchor sole plates on concrete with expansion bolts, one near each end and at not more than 6 feet o.c., or with powder-actuated fasteners, one near each end and

at not more than 3 feet o.c. Provide plates cut for the passage of pipes or ducts with a steel angle as a tie for the plate and bearing for joist.

3.1.4.3 Firestops

Provide firestops for wood framed walls and partitions and for furred spaces of concrete or masonry walls at each floor level and at the ceiling line in the top story. Where firestops are not automatically provided by the framing system used, they shall be formed of closely fitted wood blocks of nominal 2 inch thick material of the same width as the studsand joists.

3.1.4.4 Diagonal Bracing

Provide diagonal bracing at all external corners and internal angles and at maximum 40 foot centers in stud walls, except that bracing may be omitted where diagonally applied wood sheathing, plywood or structural-use panel sheathing, 4 by 8 foot fiberboard sheathing, or gypsum board sheathing is used. Bracing shall be of 1 by 6 material, let into the exterior face of studs. Extend bracing from top plates to sill at an angle of approximately 45 degrees and double nail at each stud. When openings occur near corners, provide diagonal knee braces extending from the corner post above headers to top plates and from below window sills to the main sill. Nail bracing at each bearing with two 8-penny nails.

3.1.5 Wall Sheathing

3.1.5.1 Plywood, Structural-Use, and OSB Panel Wall Sheathing

Apply horizontally or vertically. Extend sheathing over and nail to sill and top plate. Abut sheathing edges over centerlines of supports. Allow 1/8 inch spacing between panels and 1/8 inch at windows and doors. If sheathing is applied horizontally, stagger vertical end joints. Nail panels with 6-penny nails spaced 6 inches o.c. along edges of the panel and 12 inches o.c. over intermediate supports. Keep nails 3/8 inches away from panel ledges. Provide 2 by 4 blocking for horizontal edges not otherwise supported.

3.1.5.2 Gypsum Sheathing Board

Apply gypsum sheathing board either horizontally or vertically. Butt joints and locate over the centerlines of supports. Horizontally applied sheathing shall be T&G, applied with tongued edge up. Stagger vertical joints and abut sheet closely to frames of openings. Nail sheathing with 11 gage, 3/8 inch head, zinc-coated nails 1-1/2 inches long for 1/2 inch sheathing and 1-3/4 inches long for 5/8 inch sheathing, spaced 3/8 inch minimum from edges. Provide 2 by 4 blocking for horizontal edges of 4 foot wide panels not otherwise supported.

a. Gypsum Sheathing Board Used with Diagonal-Braced Framing: Sheathing shall be either 2 or 4 feet wide. Apply sheathing 2 feet wide horizontally. Nail 4 inches maximum o.c. at edges and over intermediate bearings. Apply sheathing 4 feet wide either horizontally or vertically. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Gypsum Sheathing Board Used with Unbraced Frames: Sheathing shall be 4 feet wide and applied vertically. Extend sheathing over and nail to both sill and top plates. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

3.1.5.3 Particleboard

Install according to manufacturer's instructions and accepted industry standards.

3.1.6 Wood Sheathing

Sheathing end joints shall be made over framing members and so alternated that there will be at least two boards between joints on the same support. Each board shall bear on at least three supports. Boards shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width. Roof sheathing shall not be installed where roof decking is installed.

3.1.7 Building Paper

Provide building paper where indicatedon wood board sheathing for all types of exterior siding. Apply paper shingle fashion, horizontally, beginning at the bottom of the wall. Lap edges 4 inches, and nail with one inch, zinc-coated roofing nails, spaced 12 inches o.c. and driven through tin discs.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated and specified herein. Apply nailing strips in straight parallel rows in the direction and spacing indicated specified in . Strips shall be embedded in concrete.

a. Surface-Applied Nailers: Shall be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation and for nailing of roofing felts.

b. Embedded Nailers: Shall be nominal 2 by 3 with 2 inch sides beveled. Set and anchor nailers to finish flush with the roof deck surface.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435. Strips shall be grooved for edge venting; install at walls, curbs, and other vertical surfaces with a 1/4 to 1/2 inch air space.

3.2.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, curbs for scuttles and

ventilators, and wood nailers bolted to tops of concrete or masonry curbs and at expansion joints, as indicated, specified, or necessary and of lumber or1/2" inch thick exterior plywood.

3.2.2 Rough Wood Bucks

2 inch nominal thickness. Set wood bucks true and plumb. Anchor bucks to concrete or masonry with steel straps extending into the wall 8 inches minimum. Place anchors near the top and bottom of the buck and space uniformly at 2 foot maximum intervals.

3.2.3 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.4 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 8 foot straightedge.

3.2.5 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for cornices, offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

3.2.6 Wood Bumpers

Dress to the sizes indicated, and bevel edges. Bore, countersink, and bolt bumpers in place.

3.2.7 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.8 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction. Forms and centering for cast-in-place concrete work are specified in Section 03 30 53 CAST-IN-PLACE CONCRETE.

3.2.9 Wood Sleepers

Run wood sleepers in lengths as long as practicable and stagger end joints in adjacent rows.

3.2.10 Shear Walls

Install plywood or structural-use panels with long dimension parallel or perpendicular to supports. Provide blocking behind edges not located over supports. Nail panels with 8-penny nails spaced not more than 8 inches on centers along panel edges and 6 inches o.c. over intermediate bearings.

3.2.11 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

3.2.12 Corner Bracing

Corner bracing shall be installed when required by type of sheathing used or when siding, other than panel siding, is applied directly to studs. Corner bracing shall be let into the exterior surfaces of the studs at an angle of approximately 45 degrees, shall extend completely over wall plates, and shall be secured at each bearing with two nails.

3.2.13 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

3.3 ERECTION TOLERANCES

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

   (1) Layout of walls and partitions: 1/4 inch from intended position;

   (2) Plates and runners: 1/4 inch in 8 feet from a straight line;

   (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

   (4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

   (1) Layout of walls and partitions: 1/4 inch from intended position;

   (2) Plates and runners: 1/8 inch in 8 feet from a straight line;

   (3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

   (4) Face of framing members: 1/8 in 8 feet from a true plane.

3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL

INSPECTIONS.

3.5 WASTE MANAGEMENT

In accordance with the Waste Management Plan and as specified. Separate and reuse scrap sheet materials larger than 2 square feet, framing members larger than 16 inches, and multiple offcuts of any size larger than 12 inches. Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including bracing, blocking, cripples, ties, and shims.

Separate composite wood from other wood types and recycle or reuse. Coordinate with manufacturer for take-back program and submit manufacturer's policy statement on program. Set aside scrap and return to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials. Fold up metal banding, flatten, and recycle.

Separate treated, stained, painted, and contaminated wood and place in designated area for hazardous materials. Dispose of according to local regulations. Do not leave any wood, shavings, sawdust, or other wood waste buried in fill or on the ground, unless for planned future use. Prevent sawdust and wood shavings from entering the storm drainage system. Compost sawdust. Do not burn scrap lumber that has been pressure treated, or lumber that is less than one year old.

-- End of Section --

SECTION 07 54 19
POLYVINYL-CHLORIDE AND THERMOPLASTIC POLYOLEFIN ROOFING
02/13

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/SPRI ES-1	(2003) Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.24	(2006) Roofing - Safety Requirements of Low-Sloped Roofs

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)

ARMA PMBRG98	(1998) Quality Control Guideline for the Application of Polymer Modified Bitumen Roofing

ASTM INTERNATIONAL (ASTM)

ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4434/D 4434M	(2012) Poly(Vinyl Chloride) Sheet Roofing
ASTM D6754/D6754M	(2010) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E108	(2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2012) International Building Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 3758	(2009) Guidelines for Roof-mounted Photovoltaic System Installation
NRCA 3760	Building Owners Guide to Roof-mounted Photovoltaic Systems
NRCA RoofMan	(2013) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1	(2009) Performance Standard for Retrofit Drains

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Reprint Jul 2013) Standard Test Methods for Fire Tests of Roof Coverings

1.2 SUMMARY

Loose-laid, Combination adhered polyvinyl-chloride (PVC) and (TPO) roof membrane system applied over an existing substrate.

1.3 ASSEMBLY REQUIREMENTS

Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Provide membrane which is free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Insulation shall be applied and weatherproofed on the same day.

1.3.1 Fire Resistance

Complete roof system assembly:

a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790; and

b. Be listed as Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly shall bear the appropriate FM or UL label.

1.3.2 Wind Uplift Resistance

The complete roof system assembly shall be rated and installed to resist wind loads calculated in accordance with ASCE 7 and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit Engineering calculations, signed, sealed, and dated by a Registered Engineer validating the wind resistance per ASCE 7, and ANSI/SPRI ES-1 of non-rated roof system. Base wind uplift measurements on a design wind speed of 90 mph in accordance with ASCE 7 and other

applicable building code requirements.

1.3.3 Solar Reflectance Index (SRI)

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. Use roofing materials having minimum appropriate SRI for more than 75 percent of roof surface (low slope (less than 2:12) SRI greater than 78; high slope (greater than 2:12) SRI greater than 29).

1.4 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements.

1.4.1 EPA Comprehensive Procurement Guidelines

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with EPA designated products.

1.4.2 USDA Biobased

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with USDA Biobased designated products.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
Roof plan; G

SD-03 Product Data

PVC Roofing Membrane; G
Bonding Adhesive
Flashing
Membrane Fasteners and Plates

Pre-manufactured accessories

SD-05 Design Data

Wind Uplift Resistance; G

SD-07 Certificates

Qualification of manufacturer
Qualifications of Applicator

Qualification of Engineer of Record
Wind Uplift Resistance
Fire Resistance classification
Minimum Polymer Thickness
Sample warranty; G

SD-08 Manufacturer's Instructions

Application Method; G
Membrane Flashing; G
Perimeter Attachment
Auxiliary Fasteners

Pre-manufactured accessories

SD-11 Closeout Submittals

Warranty; G

1.6 QUALITY ASSURANCE

1.6.1 Qualification of Manufacturer

Polyvinyl-Chloride sheet roofing system manufacturer must have a minimum of 5 years experience in manufacturing PVC roofing products.

1.6.2 Qualifications of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the PVC sheet roofing system manufacturer and have a minimum of five years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of five projects, within the previous three years, of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project.

1.6.3 Qualifications of Photovoltaics (PV) Rooftop Applicator

The PV rooftop applicator must be approved, authorized, or certified by a Roof Integrated Solar Energy (RISE) Certified Solar Roofing Professional (CSRP), and comply with applicable codes, standards, and regulatory requirements to maintain the weatherproofing abilities of both the integrated roof system and photovoltaic system.

1.6.4 Qualification of Engineer of Record

Engineer of Record must be currently licensed within the jurisdiction of the project.

Wind uplift requirements in accordance with Local and State codes

ASCE 7,in accordance with ICC IBC.

Seismic requirements per local and state building codes

Seismic requirements per ICC IBC Chapter 16, Section 1613

Snow load requirements per ICC IBC Chapter 16 Section 1608 and Section 7 of ASCE 7

1.6.5 Conformance and Compatibility

The entire roofing and flashing system shall be in accordance with specified and indicated requirements, including fire and wind resistance.

1.6.6 Preroofing Conference

After approval of submittals and before performing roofing system installation work, hold a preroofing conference to review the following:

a. Drawings, including roof plan, specifications and submittals related to the roof work. Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer;

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

e. Quality control(ARMA PMBRG98) plan for the roof system installation;

f. Safety requirements.

Coordinate preroofing conference scheduling with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofflashing and sheet metal work, other trades interfacing with the roof work, designated safety personnel trained to enforce and copy with ASSE/SAFE A10.24, Fire Marshall, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.7 DETAIL DRAWINGS

Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components as applicable. The drawing shall reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the PVC membrane manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Delivery

Deliver materials in the manufacturer's original, unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification number, the container shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.8.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

a. Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper and/or tarps from all torch/welding applications.

b. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.8.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.9 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

1.10 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing in accordance with NRCA RoofMan, andare installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed

materials.

1.11 WARRANTY

Provide roof system material and workmanship warranties. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 20 years. Submit sample certificate.

1.11.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year, no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.11.2 Roofing System Installer Warranty

The roof system installer shall warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.11.3 Continuance of Warranty

Aprove repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 PVC Roof Membrane

Provide a minimum polymer thickness 0.072 inch reinforced PVC as specified herein. Provide PVC system capable of obtaining 20 year warranties and as listed in the applicable wind uplift and fire rating clasification listings.

Submit Data as required with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer.

a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable for the service and climatic conditions of the installation. All warranted roof system components shall be sourced from the PVC roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.

b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

2.1.2 Bonding Adhesive

Provide PVC membrane manufacturer's low volatile organic compound (VOC) membrane adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Bonding adhesive shall not be used to bond membrane materials to each other.

2.1.3 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.4 Membrane Flashing

Membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, shall be minimum polymer thickness 0.072 inch reinforced PVC for 20year warranties, and shall be utilized as recommended and supplied by the roof

membrane manufacturer or minimum 0.072 inch thick reinforced PVC roof membrane and flashing's for 20 year warranties. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

2.1.5 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the PVC roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and Plates to be supplied and warranted for the substrate type(s) by PVC membrane manufacturer and recommended by PVC membrane manufacturer's printed data.

2.1.5.1 Stress Plates, Bar or Rail for Fasteners

Corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470 must be utilized and must be supplied by PVC roof membrane manufacturer. Stress plates shall be formed to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.5.2 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors must be suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.

2.1.6 Protection Mat

Minimum 6 ounce/square yard ultraviolet resistant polypropylene, non-woven, needle punched fabric for use as protection mat under ballast system or as recommended and supplied by the roof membrane manufacturer.

2.1.7 Pre-manufactured Accessories

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, must comply with applicable specification section, be compatible with the membrane roof system and approved for use and supplied by the PVC roof membrane manufacturer. Pre-fabricated Curbs shall be 25 gauge G90 galvanized with minimum 4 inch flange for attachment to roof nailers. Curbs shall provide minimum height of 10 inches above the finished roof membrane surface.

2.1.8 PVC Walk Tread

Scrim reinforced 0.096 inch thickness PVC membrane with a textured surface, compatible with and supplied by manufacturer of the PVC roof membrane.

2.1.9 Elevated Metal Platforms

As specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS, and as approved by the roof membrane manufacturer.

2.1.10 Roof Insulation

Insulation system and facer material shall be compatible with membrane

application specified and be approved and supplied by the PVC membrane roof manufacturer.

2.1.11 Wood Products

As specified in Section 06 10 00 ROUGH CARPENTRY, except that fire retardant treated materials shall not be in contact with PVC membrane or PVC accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.2 Reinforced, PVC Membrane

Reinforced polyvinyl chloride (PVC) membrane shall contain fibers or scrim, and shall comply with ASTM D4434/D 4434M,Type II, Grade I, or ASTM D6754/D6754M, and in all cases shall provide 0.072 inch minimum thickness for adhered application. Not withstanding the ASTM standards referenced, reinforced PVC roof membranes provided under this section shall have the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Principal polymer used in manufacture of the membrane sheet shall be PVC. Width and length of PVC membrane roofing sheet shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced PVC membrane roofing sheet dimensions to be the maximum width obtainable from PVC membrane roof manufacturer in order to minimize seams in the field of the roof.

2.3 PHOTOVOLTAIC (PV) SYSTEMS - RACK MOUNTED SYSTEMS

Adhere to NRCA 3758 and NRCA 3760

2.4 COOL ROOFS

NA

PART 3 EXECUTION

3.1 CONCRETE SURFACE DRYNESS

Prior to installing any roof system on a concrete deck, including application of insulation or membrane materials, conduct a test for surface dryness in accordance with ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.2 EXAMINATION

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

a. Curbs,control joints,roof penetrating components,andequipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

c. Substrate is sloped to provide positive drainage.

d. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

e. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

f. Pressure-preservative treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures.

g. PVC materials are not in contact with fire retardant treated wood, except as approved by the PVC membrane roof manufacturer and Contracting Officer.

h. Venting shall be provided if required by, and in accordance with the cellular lightweight concrete manufacturer's requirements and recommendations.

i. Exposed nail heads in wood substrates are properly set. Warped and split boards have been replaced. There are no cracks or end joints 1/4 inch in width or greater.

j. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width.

3.3 APPLICATION METHOD

Apply entire PVC membrane roofing utilizing adheredapplication method. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Submit instructions including pattern and frequency of mechanical attachments required in the field for roof, corners, and perimeters to provide for the specified wind resistance

3.3.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning PVC sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the PVC membrane roofing sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.3.2 PVC Roofing Membrane

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Only felt-backed membrane shall be placed directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Non-felt-backed PVC membrane roofing sheet shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Membrane shall be overlapped a minimum of 3 inches at sides for adhered applications and 5.5-7 inches for mechanically fastened applications and minimum 4 inches at ends. Direction of laps shall allow water to flow over and not against the lap. Membrane joints shall be free of wrinkles and fishmouths. The entire length of hot-air-welded seams shall be probe-tested and corrected during the day of installation. Defective areas shall be re-welded. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a continuous hot-air-welded seam on all sides. Repairs shall be probe-tested for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

3.3.2.1 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 4 inch centers maximum; screws for sheet metal shall be staggered on 8 inch centers maximum; and a row of fasteners shall be at least 1/2 inch from edges of sheet metal.

3.3.2.2 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam shall be sealed a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashing's shall be secured at the top of the flashing a maximum of12 inches on centers under the counterflashing or cap. Where possible, prefabricated components shall be used for pipe seals and flashing accessories.

3.3.2.3 Expansion Joints

Expansion joints shall be covered using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.3.2.4 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used

for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

3.3.2.5 Walkways

Walkways shall be installed on a loose-laid pad of the membrane material extending at least 1 inch beyond the walkway material, and as specified by the manufacturer. Stone ballast shall not be placed below or above walkways.

3.3.3 Adhered Membrane Application

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate and underside of sheets at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. When adhesive is peel & stick release paper-activated, follow manufacturer's printed instructions. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure adequately uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals.

3.3.4 Perimeter Attachment

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond shall be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.3.5 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 12 inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

3.3.6 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flashed with PVC membrane flashing materials.

3.3.6.1 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.7 Roof Walkways

Install walkways at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the PVC membrane roof manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkways to accommodate drainage.

3.3.8 Elevated Metal Platforms

Install over completed roof system in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the PVC membrane roof manufacturer and Contracting Officer, at all surface bearing support locations.

3.3.9 Isolated Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of reinforced PVC membrane or walkway applied over the completed PVC roof membrane.

3.4 FLASHINGS

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

3.4.1 General

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet metal reglet in which sheet metal cap flashings are installed of not more than 16 inch nor less than 8 inch above the roofing surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

3.4.2 Membrane Flashing

3.4.2.1 Installation

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured PVC membrane flashing and prefabricated accessory flashings to the maximum extent

recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 8 inch above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

3.4.2.2 Sealing

Seal flashing membrane for a minimum of 3 inch on each side of fastening device used to anchor roof membrane to nailers. Completely adhere flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 12 inch on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.4.3 Flashing at Roof Drain

Provide a tapered insulation sump into the drain bowl area. Do not exceed tapered slope of 18 degrees for unreinforced membrane and 5 degrees for reinforced membrane. Provide tapered insulation with surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 24 inch of roof drain, or as otherwise recommended by the roof membrane manufacturer. Adhere the membrane to the tapered in the drain sump area. Apply water block mastic and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Insure membrane free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes. Retrofit roof drains shall conform to ANSI/SPRI RD-1.

3.5 ROOF WALKPADS

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the roof membrane manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkpads to accommodate drainage.

3.5.1 Elevated Metal Platforms

Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.6 CORRECTION OF DEFICIENCES

Where any form of deficiency is found, additional measures must be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and provide corrective action recommendations. Perform corrective action as directed by the Contracting Officer.

3.7 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.7.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.7.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.7.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

(2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(3) The proper number, type, and spacing of fasteners are installed.

(4) Materials comply with the specified requirements.

(5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed

prior to application.

(6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required.

(7) Membrane is properly overlapped.

(8) Membrane seaming is as specified by PVC membrane manufacturer. All seams are checked at the end of each work day.

(9) Applied membrane is inspected and repaired as necessary prior to paver installation.

(10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.

(11) Installer adheres to specified and detailed application parameters.

(12) Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.

(13) Paver ballast is within the specified weight range.

(14) Temporary protection measures are in place at the end of each work shift.

3.8.2 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of 1 time during the installation for purposes of reviewing materials installation practices and adequacy of work in place. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the roofing Contractor to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.9 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Include copies of Material Safety Data Sheets for maintenance/repair materials.

3.11 ROOF DRAIN TEST

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from

roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
08/08

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/SPRI RD-1	(2004) Performance Standard for Retrofit Drains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2008) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A308/A308M	(2010) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B101	(2007) Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B32	(2008) Standard Specification for Solder Metal
ASTM B370	(2011) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B69	(2011) Standard Specification for Rolled Zinc

ASTM D 1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 226/D 226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2003) Architectural Sheet Metal Manual, 6th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing 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 Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces

Base flashing;G

Counterflashing;G

Flashing at roof penetrations

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

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA Arch. Manual for a particular item, unless otherwise specified or indicated. Conform to the requirements specified and to the thicknesses and configurations established in SMACNA Arch. Manual for the materials. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper.

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. Provide accessories made of the same or compatible 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. Provide sheet metal items with 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

Must be of the same material. Consider the following 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 B370, cold-rolled temper, H 00 (standard).

2.1.4 Lead-Coated Copper Sheet

ASTM B101.

2.1.5 Lead Sheet

Minimum weight 4 pounds per square foot.

2.1.6 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A653/A653M.

2.1.6.1 Finish

Exposed exterior items of zinc-coated steel sheet must have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils and color to match existing.

2.1.7 Zinc Sheet and Strip

ASTM B69, Type I, a minimum of 0.024 inch thick.

2.1.8 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.9 Terne-Coated Steel

Minimum of 14 by 20 inch with minimum of 40 pound coating per double base box. ASTM A308/A308M.

2.1.10 Aluminum Alloy Sheet and Plate

ASTM B209 anodized and color to match existing.

2.1.10.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on both sides unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Gravel stops and fascias

c. Flashing

2.1.10.2 Finish

Exposed exterior sheet metal items of aluminum must have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils and color to match existing.

2.1.11 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.1.12 Solder

ASTM B32, 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 Roofing Felt

ASTM D 226/D 226M Type I.

2.1.16 Asphalt Primer

ASTM D41/D41M.

2.1.17 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 Flat Copper, Zinc, and Terne-coated Steel Roofing

Before applying roofing, cover deck with rosin-sized roofing felt. Lap 2 inch at joints and secure in place with roofing nails. Using solder of equal parts tin and lead, solder slowly with well-heated irons to thoroughly heat sheet and completely sweat solder through full width of seam. Tin edges of copper to be soldered at least 3/4 inch before sheets are locked. Use stainless nails in terne-coated steel; in copper, use solid copper or bronze roofing nails, in zinc, use zinc-coated roofing nails. Where roof decks abut vertical surfaces, turn metal roofing up vertical surfaces about 8 inch where practicable; where vertical surfaces are covered with applied materials, turn up roofing behind applied materials. Use standing-seam method for roofs having rise of more than 3 inch per foot, and use flat-seam method when rise is 3 inch per foot or less. Walking not permitted directly on metal roofs; provide approved walkways.

3.1.1.2 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 inch. Then install 2 by 3 inch cleats spaced 12 inch 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 inch 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 must 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.

3.1.1.3 Flat-seam Method

Lay metal so short dimension is parallel to gutter or eave lines and so water will flow over and not into seams. Make seams by turning edges of sheet 3/4 inch and lock and solder together. If sheets are laid one at a time, secure to roof deck with cleats, using three cleats to each sheet, two on long side and one on short side. Use cleats inch wide, hooked over 3/4 inch upturned edges of sheets, and nail to roof deck with two one inch long nails. Turn back roof end of cleat over nail heads before next sheet is applied. If desired, sheets may be made into long lengths at shop by locking short dimensions together and soldering seams thus formed. Turn long lengths 3/4 inch, and secure each length to roof deck by cleats spaced 12 inch apart. Mallet and solder seams after pans are in place." All sheets to 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 and angles sharp and true. Free exposed surfaces from visible wave, warp, 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. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, 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 inch. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center 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.

3.1.4 Cleats

Provide cleats for sheet metal 18 inch and over in width. Space cleats evenly not over 12 inch on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inch wide by 3 inch 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, use screws and drive 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. Provide mechanically formed joints in aluminum sheets 0.040 inch or less in thickness.

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 inch.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 3 inch 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, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pretin edges of sheet metal 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 must 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/D1.2M.

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 inch maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inch 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

Do not allow aluminum surfaces in direct contact with 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. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. 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 Base Flashing

Lay the base flashings with each course of the roof covering, shingle fashion, where practicable, where sloped roofs abut chimneys, curbs, walls, or other vertical surfaces. Extend up vertical surfaces of the flashing not less than 8 inch and not less than 4 inch under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inch. Overlap the flashing strips with the previously laid flashing not less than 3 inch. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inch on center with hex headed, galvanized shielded screws a minimum of 2-inch lap of any surface. Solder end laps and provide for expansion and contraction.

Extend the metal flashing over crickets at the up-slope side of curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inch at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inch above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inch. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inch by 8 inch or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inch 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 inch from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inch apart; on stair/elevator towers short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. 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 inch into the walls. Install counterflashing to provide a spring action against base flashing.

3.1.13 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1 1/4 inch, as approved.

3.1.13.1 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 inch, caulked full and solid with an approved compound.

3.1.13.2 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 inch 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 inch on center maximum. When the flashing has been inserted the full depth, caulk the slot and lock with wedges and fill with sealant.

3.1.14 Polyvinyl Chloride Reglets

Rigid polyvinyl chloride reglets ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness may be provided in lieu of metal reglets for temporary construction.

3.1.15 Gravel Stops and Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less that 8 feet. Extend flange at least 4 inch 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 inch long spaced not more than 3 inch on center, in two staggered rows.

3.1.15.1 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 inchmaximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inch on center 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.

3.1.15.2 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 inch 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.

3.1.16 Metal Drip Edge

Provide a metal drip edge, 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 inch and secure with compatible nails spaced not more than 10 inch on center along upper edge.

3.1.17 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inch minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on by continuous cleats or by cleats spaced not less than 36 inch apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.1.18 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.18.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.19 Flashing for Roof Drains

Provide a 30 inch square sheet indicated. Taper insulation to drain from 24 inch out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Heavily coat the drain flashing ring with asphalt roof cement. 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. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.1.20 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.

3.1.21 Conductor Heads

Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 4 inch long. Flat-lock solder the seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inch wider than the scupper. Attach conductor heads to the wall with masonry fasteners, and loose-lock to provide conductor heads with screens of the same material. Securely fasten screens to the heads.

3.1.22 Splash Pans

Install splash pans where downspouts discharge on roof surfaces and at

other locations as indicated. Unless otherwise shown, provide pans not less than 24 inch long by 18 inch wide with metal ribs across the bottom of the pan. Form the sides of the pan with vertical baffles not less than one inch high in the front, and 4 inch high in the back doubled over and formed continuous with horizontal roof flanges not less than 4 inch wide. Bend the rear flange of the pan to contour of cant strip and extend up 6 inch under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.23 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 6 inch under the roof covering on each side. Provide a 1/2 inch fold on each side of the valley flashing. Lap the sheets not less than 6 inch in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 12 inch on center. Provide exposed flashing not less than 4 inch in width at the top and increase one inch in width for each additional 8 feet in length. Where the slope of the valley is 4.5 inch or less per foot, or the intersecting roofs are on different slopes, provide an inverted V-joint, one inch high, along the centerline of the valley; and extend the edge of the valley sheets 8 inch under the roof covering on each side.

3.1.24 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 inch on center. Locate the upper edge of flashing not less than 18 inch 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 inch on center.

3.1.25 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 inch. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.26 Expansion Joints

Provide expansion joints for roofs, walls, and floors as specified. Provide expansion joints in continuous sheet metal at 40 foot intervals for copper and stainless steel, aluminum gravel stops and fascias must have expansion joints at not more than 12 foot spacing. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.1.26.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph "Counterflashing," except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than one inch for flashing on one side of the expansion joint and be less than the width of the expansion joint plus one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

3.1.26.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.1.27 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.

3.1.28 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inch on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inch. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inch on center. Extend sleeve a minimum of8 inch above the roof deck and lapped a minimum of 3 inch by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.29 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.1.30 Copings

Provide coping using copper sheets 8 or 10 feet long joined by a 3/4 inch locked and soldered seam. Terminate outer edges in edge strips. Install with sealed lap joints as indicated.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint.

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. Remove work that is not in compliance with the contract and replace or correct. Include quality control, 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.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Building Expansion Joints					
Cover	16	.032	.015	.015	24
Waterstop-bellows or flanged, U-type.	16	-	.015	.015	-
Covering on minor flat,					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
pitched or curved surfaces	20	.040	.018	.018	-
Downspouts and leaders	16	.032	.015	.015	24
Downspout clips and anchors	-	.040 clip	-	-	-
	-	.125 anchor	-	-	-
Downspout straps, 2-inch	48(a)	.060	.050	-	-
Conductor heads	16	.032	.015	.015	-
Scupper lining	20	.032	.015	.015	-
Strainers, wire diameter or gage	No. 9 gage	.144 diameter	.109 diameter		-
Flashings:					
Base	20	.040	.018	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Eave	16	-	.015	.015	24
Spandrel beam	10	-	.010	.010	-
Bond barrier	16	-	.015	.015	-
Stepped	16	.032	.015	.015	-
Valley	16	.032	.015	.015	-
Roof drain	16(b)				
Pipe vent sleeve(d)					
Coping	16	-	-	-	-
Gravel stops and fascias:					
Extrusions	-	.075	-	-	-
Sheets, corrugated	16	.032	.015	.015	-
Sheets, smooth	20	.050	.018	.018	24
Edge strip	24	.050	.025	-	-
Gutters:					
Gutter section.....	16	.032	.015	.015	24
Continuous cleat.....	16	.032	.015	.015	24
Hangers, dimensions	1 inch by 1/8 inch (a)	1 inch by .080 inch (c)	1 inch by .037 inch	-	-
Joint Cover plates.. . (See Table II)	16	.032	.015	.015	24
Reglets (c)	10	-	.010	.010	-
Splash pans	16	.040	.018	.018	-

(a) Brass.

(b) May be lead weighing 4 pounds per square foot.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage

(c) May be polyvinyl chloride.

(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	- - -
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.
Reglets	Butt joint	- - -	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated One inch	One inch flat locked, locked, cleated one inch	Same as base flashing.

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
	loose locked, expansion joint cleated	loose locked, sealed expansion joints, cleated	
Stepped	3 inch lap	3 inch lap	- - -
Valley.	6 inch lap cleated	6 inch lap cleated	- - -
Edge strip	Butt	Butt	- - -
Gravel stops:			
Extrusions	- - -	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate.
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked, riveted, and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.

(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.

(b) Seal polyvinyl chloride reglet with manufacturer's recommended sealant.

-- End of Section --

SECTION 07 61 14.00 20

STEEL STANDING SEAM ROOFING
05/11

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 IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2013) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A1011/A1011M	(2013) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D2244	(2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2011) Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2008) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D968	(2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

1.2.3 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.4 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.5 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

a. Panels shall be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets shall be in continuous contact from eave to ridge. Individual panels of snap together type systems shall be removable for replacement of damaged material.

b. There shall be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel shall be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes. There shall be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.

c. Snap together type systems shall have a capillary break and a positive side lap locking device. Field-formed seam type systems shall be mechanically locked closed by the manufacturer's locking tool. The seam shall include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.

d. Roof panel anchor clips shall be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

The system shall be designed to resist positive and negative loads specified herein in accordance with the AISI SG03-3. Panels shall support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of 90 miles per hour (mph). Roof system and attachments shall resist the following wind loads, in pounds per square foot (psf):
The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

a. Single fastener in a connection: 3.0

b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be 20 psf.

1.3.2.3 Thermal Movement

System shall be capable of withstanding thermal movement based on a temperature range of 10 degrees F below and 180 degrees F.

1.3.2.4 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) shall be in accordance with ASTM E1592.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing; G; G,

Submit roofing drawings to supplement the instructions and diagrams. Drawings shall include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA 1793. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Roofing panels; G; G,

Attachment clips

Closures

Accessories

Fasteners

Sealants
Insulation, including joint sealing measures for vapor barrier

facing

Sample warranty certificate; G; G,

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture selected. When colors are not indicated, submit samples of not less than six different manufacturer's standard colors for selection.

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

Sealants

Intermediate Support Section

Submit full size samples of each intermediate support section, 12 inches long.

SD-05 Design Data

Design calculations

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph entitled "Manufacturer's Field Inspection."

Structural performance tests

Finish tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained,

has the specified experience, and authorized by the manufacturer to install the products specified.

Coil stock compatibility; G; G,

Provide certification of coil compatibility with roll forming machinery to be used for forming panels without warping, waviness, and rippling not part of panel profile; to be done without damage, abrasion or marking of finish coating.

SD-08 Manufacturer's Instructions

Installation manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information card

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

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph entitled "Wind Uplift."

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing work, including associated work, is preformed, the Contracting Officer will hold a preroofing conference to review the following:

a. The drawings and specifications

b. Procedure for on site inspection and acceptance of the roofing

substrate and pertinent structural details relating to the roofing system

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

d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing installation, mechanicalandelectrical work, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun. Prepare written minutes of the preroofing conference and submit to the Contracting Officer.

1.6.2 Manufacturer

The SSMRS shall be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative shall be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer shall be factory-trained, approved by the metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer; shall be the latest design by the manufacturer; and shall have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels shall meet the following test requirements:

a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D522, exterior coating film shall show only slight microchecking and no loss of adhesion.

b. Accelerated Weathering Test: Withstand a weathering test for a minimum

of 2000 hours in accordance with ASTM G152 and ASTM G153, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument shall be considered to indicate loss of adhesion.

c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating shall not chalk greater than No. 8 rating when measured in accordance with ASTM D4214 test procedures.

d. Color Change Test:

After the 2000-hour weatherometer test, exterior coating color change shall not exceed 2 NBS units when measured in accordance with ASTM D2244 test procedure.

e. Salt Spray Test: Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 8, few blisters in field as determined by ASTM D714; and an average rating of 6, 1/8 inch failure at scribe, as determined by ASTM D1654. Rating Schedule No. 1.

f. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D968, coating system shall withstand a minimum of 50 liters of sand per mil thickness before appearance of base metal.

g. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage, or corrosion.

h. Gloss Test: The gloss of the finish shall be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D523.

i. Glare Resistance Test:

Surfaces of panels that will be exposed to the exterior shall have a specular reflectance of not more than 10 when measured in accordance with ASTM D523 at an angle of 85 degrees. Specular reflectance may be obtained with striations or embossing. Requirements specified under "Formability Test" will be waived if necessary to conform to this requirement.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period shall be not less than 20 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting

Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. The Contractor shall also provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Damaged or permanently stained materials that cannot be restored to like-new condition shall be replaced with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Panels shall have interlocking ribs for securing adjacent sheets. System for securing the roof covering to structural framing members shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps shall be predrilled or prepunched; factory prepare ends of panels to be lapped by trimming part of seam, die-setting or swaging ends of panels. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. When length of run exceeds 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not less than 12 inches of coverage in place. Height of corrugations of adjacent roof sheets shall match existing panel height. Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Panels from coil stock shall be formed without warping, waviness or ripples not part of the panel profile and shall be free of damage to the finish coating system.

2.1.1 Material

Zinc-coated steel conforming to ASTM A653/A653M, G90coating designation or

aluminum-zinc alloy coated steel conforming to ASTM A792/A792M, AZ 55 coating. Minimum thickness to be 0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 60 psf or greater, entire roof system shall have a minimum thickness of 0.030 inch (22 gage). Prior to shipment, treat mill finish panels with a passivating chemical and oil to inhibit the formation of oxide corrosion products. Dry, retreat, and re-oil panels that have become wet during shipment or storage but have not started to oxidize.

2.1.2 Texture

Smooth with raised intermediate ribs for added stiffness.

2.1.3 Finish

Factory color finish.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally cured coating to exterior and interior of metal roof and wall panels and metal accessories. Provide exterior finish top coat of Provide exterior primer standard with panel manufacturer with not less than 0.8 mil dry film thickness. Interior finish shall consist of the same coating and dry film thickness as the exterior coating. Provide exterior and interior coating meeting test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided. Provide clear factory edge coating on all factory cut or unfinished edges.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A653/A653M, G90, Grade D (16 gage and heavier), Grade A (18 gage and lighter); or steel conforming to ASTM A36/A36M, ASTM A1011/A1011M , or ASTM A1008/A1008M prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load, and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A1011/A1011M, or ASTM A1008/A1008M steel hot-dip galvanized in accordance with ASTM A653/A653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal shall be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures shall not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material shall not absorb water.

2.4.2 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4.2.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

2.4.2.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than one inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant shall cure

to a rubberlike consistency. Concealed sealant shall be the non-hardening type. Seam sealant shall be factory-applied, non-skinning, non-drying, and shall conform to the roofing manufacturer's recommendations. Silicone-based sealants shall not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.4.4 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

THERMAL INSULATION

Flexible blanket, rigid, or semi-rigid faced with a flexible vapor retarder. Insulation and facing shall have a flame-spread rating of 50 or less in accordance with ASTM E84. Vapor retarder facing shall have a permeance rating of 0.05 perm or less. Provide a thermal resistance "R" value of 30 or more.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.2.2 Contact with Wood

Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels shall be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened.

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the junction of ventilators, curbs, skylights, chimneys, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels. Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment shall allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated shall be in accordance with the SMACNA 1793, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.3 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.4 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal

shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Additional inspections shall not exceed one for 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date. After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.7 COMPLETED WORK

Completed work shall be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.8 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inchthick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated.

3.9 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. NAVFAC Specification Number:

4. Deck/Substrate Type:

5. Slopes of Deck/Roof Structure:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: (x)Yes ( )No

9. Vapor Retarder Type:

10. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name: c. Width: d. Gage:
e. Base Metal: f. Method of Attachment:

11. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

12. Statement of Compliance or Exception:_____
_____
_____

13. Date Roof Completed:

14. Warranty Period: From_____ To_____

15. Roofing Contractor (Name & Address):

16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
05/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM E 119	(2011) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	(1997; R 2009) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2007) Fire-Resistive Joint Systems
ASTM E 2174	(2010a) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E 2307	(2010) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E 2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
ASTM E 814	(2011a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2011a) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM AS 4991	(2001) Approval of Firestop Contractors

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Reprint Mar 2010) Fire Tests of Through-Penetration Firestops

UL 2079	(2004; Reprint Jun 2008) Tests for Fire Resistance of Building Joint Systems
UL 723	(2008; Reprint Sep 2010) Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2011) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

1.2.1 General

Furnish and install tested and listed firestopping 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.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. 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.

c. 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 and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2.2 Sequencing

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, 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. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.2.3 Submittals Requirements

a. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance 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 judgment, 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 a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F"

"T" and "L" ratings, and type of application.

b. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification from UL of passing the "Aging and Environmental Exposure Testing " portion of UL 1479.

c. Submit documentation of training and experience for Installer.

d. Submit 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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials

SD-07 Certificates

Manufacturer's Technical Representative
Firestopping Materials.
Installer Qualifications
Inspection

1.4 QUALITY ASSURANCE

1.4.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, operating as a UL Certified Firestop Contractor, or

b. 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 in accordance with 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 installer qualifications 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. The installer shall obtain from the manufacturer written certification of training, and retain proof of certification for duration of firestop installation.

1.4.2 Manufacturer's Technical Representative

The manufacturer's technical representative shall be a direct representative of the manufacturer (not a distributor or an agent). Provide current documentation from the manufacturer that he or she is a direct representative of the manufacturer and is qualified to preform the

specified inspections and certify the firestopping installation.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements. Remove damaged or deteriorated materials from the site.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic, water-based, noncombustible products FM APP GUIDE approved, or UL listed, 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 Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment. Firestop material must be free from Ethylene Glycol, PCB, MEK, or other types of hazardous chemicals.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: Rating of wall or partition being penetrated.

b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: Where the penetrating item is outside of a wall cavity the F rating and T rating must be equal to the fire resistance rating of the floor penetrated.

c. Penetrations of Fire and Smoke Resistance Rated Walls, Floors,

Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies: Where L rating is required.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, 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 in accordance with ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Material Performance

All firestop materials are subject to these minimum standards of performance.

a. Firestop material shall be capable of installation at temperatures of 35 to 120 degrees F.

b. Material must be able to be frozen, thawed and still maintain manufacturer approval for installation.

c. Firestop material must convey a manufacturer's written warranty guaranteeing the performance of the material for the sustainable lifetime of the structure.

d. Material must maintain a shelf life of no less than 2 years form date of manufacturing.

e. Acceptable firestop cast-in-place devices are factory assembled intumescent lined round or oval plastic cylinders capable of protecting plastic, metallic, cable, and blank openings through the cast-in-place device equal to the fire-resistance rating of the floor.

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. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material 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. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems 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. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products. Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0% to 100% visual fill of penetrants; while maintaining "L" rating of <5 cfm/sf measured at ambient temperature and 400* F at 0% to 100% visual fill. Each device must be capable of retrofit applications and be available in square and round configurations, with single, double, triple and six-plex bracket systems provided. Firestop devices must also allow for plastic pipe, metallic pipe, and mixed multiple penetrations through a single device.

3.3 INSPECTION

3.3.1 General Requirements

At this inspection, the manufacturer's technical representative of the firestopping material shall be present. For all projects, the remainder of

the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The 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. 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.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM standards for firestop inspection, and document inspection results to be submitted to GC, Architect and Owner.

a. ASTM E 2393

b. ASTM E 2174

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
01/07

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.

ASTM INTERNATIONAL (ASTM)

ASTM C1311	(2010) Standard Specification for Solvent Release Agents
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2006) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2008) Use of Sealants in Acoustical Applications
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 217	(2010) Cone Penetration of Lubricating Grease
ASTM D 2452	(2003; R 2009) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D 2453	(2003; R 2009) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E 84	(2011a) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet 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 CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up, using materials and techniques approved for use on the project.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water

penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As selected
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As selected
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	As selected
e.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected
f.	Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	As selected
g.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	As selected
h.	Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b.	Joints between new and existing exterior masonry walls.	As selected
c.	Masonry joints where shelf angles occur.	As selected
d.	Joints in wash surfaces of stonework.	As selected
e.	Expansion and control joints.	As selected
f.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	As selected
g.	Voids where items pass through exterior walls.	As selected
h.	Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	As selected
i.	Metal-to-metal joints where sealant is indicated or specified.	As selected
j.	Joints between ends of gravel stops, fascias, copings, and adjacent walls.	As selected

2.1.3 Floor Joint Sealant

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Seats of metal thresholds for exterior doors.	As selected
b.	Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As selected

2.1.4 Acoustical Sealant

Rubber or polymer-based acoustical sealant conforming to ASTM C919 must 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. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734, and must be non-staining.

2.1.5 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class D, Grade 5 cellular rubber sponge backing.

2.4.2 PVC

Conform to ASTM D 1667, Grade VO 12, open-cell foam, Polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Conform to ASTM C509, Option I , Type II preformed rods or tubes for Synthetic rubber backing.

2.4.4 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 Neoprene backing.

2.4.5 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C1311.

2.4.6 Silicon Rubber Base

Provide Silicon Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C920, Non-sag, Type S, Grade NS, Class 25.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453, Type I, for Oil- and resin-based caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, stone		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch.	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply

the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
02/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2012; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	(2012) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C578	(2012b) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2012a) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	(2010) Mineral Fiber Block and Board Thermal Insulation
ASTM D2863	(2012) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E283	(2004; R 2012) 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)

ANSI/BHMA A156.115	(2006) Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	(2013) Standard for Installation of Smoke Door Assemblies and Other Opening Protectives
NFPA 252	(2012) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	(2001; R2006) Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	(2001) Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.6	(2003; R2009) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10C	(2009) Standard for Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware

provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples

Factory-applied enamel finish; G

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

SDI/DOOR A250.8, Level 1, physical performance Level C, Model 1, of size(s) and design(s) indicated and core construction as required by the manufacturer.

2.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

2.2 INSULATED STEEL DOOR SYSTEMS

At the option of the Contractor, insulated steel doors and frames may be provided in lieu of Grade I standard steel doors and frames. 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 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer. Doors shall have been tested in accordance with SDI/DOOR A250.4 and shall have met the requirements for Level C. Prepare doors to receive specified hardware.Doors shall be 1-3/4 inch thick.

2.3 Interior Louvers

SDI/DOOR 111, Louvers shall be stationary. 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. louvers to be inverted "V" blade design with minimum 55 blade design with minimum 40 percent net-free opening.

2.4 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors. For interior pairs of fire ratedandsmoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.5 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.6 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Rigid Cellular Polyisocyanurate Foam: ASTM C591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

2.7 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 1, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners . Provide steel frames for

doors, transoms,sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated.

2.7.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.7.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto . Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.7.3 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 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.7.4 Terminated Stops

Where indicated, terminate interior door frame stops 6 inch above floor.

2.7.5 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.

2.7.6 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.

2.7.6.1 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/DOOR 111;

and

d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

2.7.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.8 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 andNFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.8.1 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 10C. 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.

2.8.2 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.

2.8.3 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.

2.9 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.9.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283.

2.10 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR 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 SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames , with the exception of frames that will have weatherstripping 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.

2.11 FINISHES

2.11.1 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 SDI/DOOR A250.8. , or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.11.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate interior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. 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 SDI/DOOR A250.8.

2.11.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.12 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. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.12.1 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.

2.13 PROVISIONS FOR GLAZING

NA.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. 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. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. 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.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F883	(2009) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2013) Butts and Hinges
ANSI/BHMA A156.13	(2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2008) Auxiliary Hardware
ANSI/BHMA A156.17	(2004; R 2010) Self Closing Hinges & Pivots
ANSI/BHMA A156.18	(2012) Materials and Finishes
ANSI/BHMA A156.2	(2011) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	(2009) Thresholds
ANSI/BHMA A156.3	(2008) Exit Devices
ANSI/BHMA A156.4	(2008) Door Controls - Closers
ANSI/BHMA A156.5	(2010) Auxiliary Locks and Associated Products
ANSI/BHMA A156.6	(2010) Architectural Door Trim
ANSI/BHMA A156.7	(2003; R 2009) Template Hinge Dimensions
ANSI/BHMA A156.8	(2010) Door Controls - Overhead Stops and Holders
BHMA A156.15	(2011) Release Devices Closer Holder, Electromagnetic and Electromechanical
BHMA A156.22	(2012) Door Gasketing and Edge Seal Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2012; Amendment 1 2012) Life Safety Code
NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2012) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule; G

Keying system

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publi- cation Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed	BHMA Finish Desig- nation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.5.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.1.1 Protection Devices

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Hinge-side protection device shall be provided on both sides of the doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device shall push hand and/or fingers out of the opening and away from a crushing hazard.

2.3.2 Pivots

ANSI/BHMA A156.4.

2.3.3 Spring Hinges

ANSI/BHMA A156.17.

2.3.4 Locks and Latches

2.3.4.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.4.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1.

2.3.4.3 Residential Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 2. Install locks for exterior doors with threaded roses or concealed machine screws.

2.3.4.4 Provide F96 or F97, unless otherwise specified.

2.3.4.5 Auxiliary Locks

ANSI/BHMA A156.5, Grade 1.

2.3.5 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2-1/4 inch.

2.3.6 Cylinders and Cores

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders with products of the Best Lock Corporation with interchangeable cores which are removable by a special control key. Factory set the cores with seven pin tumblers using the A4 system and F keyway. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

2.3.7 Keying System

Provide a great master keying system Provide construction interchangeable cores.

The Government will provide permanent cylinders with cores and keys for mortise locksets, auxiliary locks, and exit devices. Furnish cylinders as manufactured by Best Lock Corp., Arrow Lock Corp., or Falcon Lock. Notify the Contracting Officer 90 days prior to the required delivery of the cylinders. Provide temporary cores and keys for the Contractor's use during construction, and for testing the locksets.

2.3.8 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.8.1 Knobs and Roses

Conform to the minimum test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

2.3.8.2 Lever Handles

Provide lever handles in lieu of knobs . Conform to the minimum requirements of ANSI/BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as

a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.8.3 Texture

Provide knurled or abrasive coated knobs or lever handles where specified in paragraph entitled "Hardware Schedule" for doors which are accessible to blind persons and which lead to dangerous areas.

2.3.9 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish construction master keys,and control keys for removable cores. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.10 Door Bolts

ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.3.11 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, pivots, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.11.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.12 Overhead Holders

ANSI/BHMA A156.8.

2.3.13 Closer Holder-Release Devices

BHMA A156.15.

2.3.14 Door Protection Plates

ANSI/BHMA A156.6.

2.3.14.1 Sizes of Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doorsand 1 inch less than height of bottom rail for panel doors. Provide a minimum 36 inch armor plates for flush doors and completely cover lower panels of

panel doors, except 16 inch high armor plates on fire doors.

2.3.15 Edge Guards

ANSI/BHMA A156.6, stainless steel, of same height as armor plates. Apply to hinge stile .

2.3.16 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.17 Padlocks

ASTM F883.

2.3.18 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.19 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals,and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weather stripping with one of the following:

2.3.19.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide bronze anodized aluminum.

2.3.19.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

2.3.19.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.3.20 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, clear bronze anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.20.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.20.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.21 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Provide hardware in BHMA 612 finish satin bronze, unless specified otherwise. Finish surface door closers prime coat finish. Provide steel hinges in BHMA 639 finish satin bronze plated. Provide exposed parts of concealed closers finish to match lock and door trim. Match hardware finish for aluminum doors to match the doors. Provide hardware showing on interior of toilet rooms in BHMA 629 finish bright stainless steel or BHMA 625 finish bright chromium plated.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 1 inch on center and to heads and jambs at 4 inch on center

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb

stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors .

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS

Provide hardware as noted on the drawings.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
02/10

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2010) Seismic Provisions for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2010) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2013) Nonstructural Steel Framing Members
ASTM C754	(2011) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C841	(2003; E 2008; R 2008) Installation of Interior Lathing and Furring
ASTM C847	(2012) Standard Specification for Metal Lath

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM EMLA 920	(2009) Guide Specifications for Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2012) Fire Resistance Directory

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal support systems; G

Submit for the erection of metal framing, furring, andceiling 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 A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per AISC 341andUFC 3-310-04, "Seismic Design for Buildings" in seismic zones.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, and ASTM C847.

2.1.1.2 Non-loadbearing Wall Framing

NAAMM EMLA 920.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C645.

2.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0247 inch thickness, with 0.0396 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

2.1.2.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance 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, with 1-1/4 inch and 3/4 inch flanges.

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 C841, except as indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing

NAAMM EMLA 920, except provide framing members 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 C754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.2.2 Non-loadbearing Wall Framing and Furring

ASTM C754, 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 Resistance, 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 masonryand 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

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, 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.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD
05/11

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 A108.11	(1992; Reaffirmed 2005) Specifications for Interior Installation of Cementitious Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	(2010a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1178/C1178M	(2011) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	(2013) Standard Specification for Gypsum Board
ASTM C1629/C1629M	(2006; R 2011) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	(2012) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	(2004; E 2009; R 2009) Standard Specification for Nails for the Application of Gypsum Board
ASTM C840	(2011) Application and Finishing of Gypsum Board
ASTM C954	(2011) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D2394	(2005; R 2011) Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D5420	(2010) Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM D624	(2000; R 2012) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM E695	(2003; R 2009) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E84	(2012c) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products
GA 224	(2008) Installation of Predecorated Gypsum Board
GA 253	(2007) Application of Gypsum Sheathing

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2012) Fire Resistance Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-03 Product Data

Cementitious backer units

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-04 Samples

Predecorated gypsum board

Submit for each color and pattern of predecorated gypsum board. Where colors are not indicated, submit color selection samples of not less than eight of the manufacturer's standard colors.

SD-07 Certificates

Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer maintenance instructions

Waste Management

SD-11 Closeout Submittals

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. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

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

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.2 Foil-Backed

48 inch wide, 5/8 inch thick, tapered edges.

2.1.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.4 Gypsum Backing Board

ASTM C1396/C1396M, gypsum backing board shall be used as a base in a multilayer system.

2.1.4.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.4.2 Foil-Backed

48 inch wide, 5/8 inch thick, square edges.

2.1.4.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.5 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.5.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.5.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.6 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

2.1.6.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.6.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.7 Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Provide sealant compatible with gypsum sheathing, rubber washers for masonry veneer anchors, and other associated cavity wall components such as anchors and through wall flashing. Provide sealants for gypsum sheathing board edge seams and veneer anchor penetrations recommended by the gypsum sheathing manufacturer and have the following performance requirements:

a. ASTM D412: Tensile Strength, 80 psi
b. ASTM D412: Ultimate Tensile Strength (maximum elongation), 170 psi
c. ASTM D624: Tear Strength, dieB, 27 ppi
d. ASTM D1149: Joint Movement Capability after 14 Days cure, plus or minus 50 percent.

2.1.8 Impact Resistant Gypsum Board

48 inchwide, 5/8 inch thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Hard body impact test must attain a Level 2 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in

accordance with ASTM E84, have a flame spread rating of 75 or less and a smoke developed rating of 100 or less.

2.1.8.1 Structural Failure Test

ASTM E695 or ASTM D2394 for structural failure (drop penetration). ASTM E695 using a 60 lb sand filled leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.8.2 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.9 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

2.1.10 Joint Treatment Materials

ASTM C475/C475M. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.10.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.10.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.10.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.10.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.10.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.11 Fasteners

2.1.11.1 Nails

ASTM C514.

2.1.11.2 Screws

ASTM C1002, 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 C954 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.

2.1.11.3 Staples

No. 16 USS gageflattened 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	Thickness of Gypsum Board
1-1/8 inches	1/2 inch
1-1/4 inches	5/8 inch

2.1.12 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene. Adhesive shall contain a maximum VOC content of 50 grams per liter.

2.1.12.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted.

2.1.12.2 Adhesive for Fastening Gypsum Board to Wood Framing

Not permitted.

2.1.12.3 Adhesive for Laminating

Not permitted.

2.1.13 Gypsum Studs

Provide one inch minimum thickness and 6 inch minimum width. Studs may be of one inch thick gypsum board or multilayers fastened to required thickness. Conform to ASTM C1396/C1396M for material.

2.1.14 Shaftwall Liner Panel

ASTM C1396/C1396M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1" thick, by 24" wide.

2.1.15 Accessories

ASTM C1047. 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.

2.1.16 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.17 Water

Provide clean, fresh, and potable water.

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

Verify that surfaces of gypsum board 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 C840 or GA 216 and the requirements specified. 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; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight 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. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may notbe bonded together with an adhesive. 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 Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C840, System I or GA 216.

3.2.2 Application of Two-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C840, System II or GA 216.

3.2.3 Adhesive Nail-On Application to Wood Framing

Apply in accordance with ASTM C840, System III or GA 216. This method may be used in lieu of ASTM C840, System I at the option of the Contractor.

3.2.4 Semi-Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System IV or GA 216 .

3.2.5 Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System V or GA 216.

3.2.6 Adhesive Application to Interior Masonry or Concrete Walls

Apply in accordance with ASTM C840, System VI or GA 216.

3.2.7 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.8 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C840, System IX or GA 216.

3.2.9 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with ASTM C840, System X or GA 216.

3.2.10 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C840, System XI or GA 216.

3.2.11 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publications GA 253. Follow gypsum sheathing manufacturer's requirements of design details for joints and fasteners and be properly installed to protect the substrate from moisture intrusion. Do not leave exposed surfaces of the gypsum sheathing beyond the manufacturer's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in shingle fashion with edges and ends lapped a minimum of 6 inch. Property flash the openings. Seal all joints, seams, and penetrations with a compatible silicone sealant.

3.2.12 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C840, System XII or GA 216, for single-ply and

two-ply applications of gypsum board to wood framing.

3.2.13 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.2.14 Application of Foil-Backed Gypsum Board

Apply foil-backed gypsum board in accordance with ASTM C840, System XIV or GA 216.

3.2.15 Application of Predecorated Gypsum Board

Apply predecorated gypsum board in accordance with GA 224. Attach predecorated gypsum board with adhesive and fasteners as recommended by the manufacturer. Conceal fasteners in the finished work.

3.2.16 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

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. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane 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 C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. 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. Protect workers, building occupants, and HVAC systems from gypsum dust.

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 as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.9 WASTE MANAGEMENT

As specified in Waste Management Plan.

Identify manufacturer's policy for collection or return of remaining construction scrap, unused material, demolition scrap, and packaging material. Institute demolition and construction recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS
08/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM A489	(2012) Standard Specification for Carbon Steel Lifting Eyes
ASTM A641/A641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2013) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C834	(2010) Latex Sealants
ASTM E119	(2012a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E1264	(2008; E 2010) Acoustical Ceiling Products
ASTM E1414/E1414M	(2011a) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998a; R 2013) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E580/E580M	(2011b) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E795	(2005; R 2012) Mounting Test Specimens During Sound Absorption Tests
ASTM E84	(2012c) Standard Test Method for Surface

Burning Characteristics of Building Materials

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2012) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance (2012) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

1.2.1 Fire Resistive Ceilings

Rate acoustical ceiling systems, indicated as fire resistant, for fire endurance as specified when tested in accordance with ASTM E119. Provide ceiling assembly rating for 1 hour as shown on drawings. Provide acoustical units with a flame spread of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E84.

1.2.2 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of 40 minimum when determined in accordance with ASTM E1414/E1414M. 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. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.2.3 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423 Test Method.

1.2.4 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 Test Method.

1.2.5 Other Submittals Requirements

The following shall be submitted:

a. Manufacturer's data indicating percentage of recycle material in acoustic ceiling tiles to verify affirmative procurement compliance.

b. Total weight and volume quantities of acoustic ceiling tiles with recycle material.

c. Manufacturer's catalog showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating for each required floor or roof construction and acoustic ceiling assembly.

d. Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified fire endurance and sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

e. 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 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-03 Product Data

Acoustical Ceiling Systems

SD-04 Samples

Acoustical Units
Acoustic Ceiling Tiles

SD-06 Test Reports

Fire Resistive Ceilings
Ceiling Attenuation Class and Test

SD-07 Certificates

Acoustical Units
Acoustic Ceiling Tiles

1.4 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 20 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS. Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

2.1.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

Product	Material	Percent of Post Consumer Materials	Percent of Total Recovered Materials
Laminate Paperboard	Post Consumer Paper	100	100
Rock Wool	Slag	75	
Cellulose	Post Consumer Paper	75	75

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

c. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System

a. Type: I (cellulose composition).

b. Flame Spread: Class A, 25 or less

c. Pattern: A .

d. 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 E795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 24 by 48 inch.

g. Edge detail: Reveal .

h. Finish: Factory-applied standard finish .

i. Minimum CAC: 40.

2.1.3 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 C423 and reported as a 4 frequency average.

2.2 SUSPENSION SYSTEM

Provide standard exposed-gridwidth flange suspension system conforming to ASTM C635/C635M. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 15/16 inch. Provide inside and outside corner caps . Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in UFC 3-310-04 and ASTM E580/E580M.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge).

2.3.2 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.3.3 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Eyebolt size must be a minimum 1/4 inch, zinc coated.

2.3.4 Masonry Anchorage Devices

Comply with ASTM C636/C636M for anchorage devices .

2.4 ADHESIVE

Use adhesive as recommended by tile manufacturer.

2.5 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.6 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components in Conference Rooms 113A & B; Armstrong Ultima and tegular Lay-In and Second Floor Conference Room 230; Armstrong Cloud Cirrus Second Look, Scored Tegular, Medium Texture Linear Tile or approved equal.

2.7 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system 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. Ensure that contact area of each daub is at least 2 inch 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

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or

improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
05/11

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 0100Doc	(2005) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D 235	(2002; R 2007) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(2008) Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM F 1869	(2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 107	(Oct 2009) Rust Inhibitive Primer (Water-Based)
MPI 42	(Oct 2009) Latex Stucco and Masonry Textured Coating

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel

SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2004) Hand Tool Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC VIS 1	(2002; e 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

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

29 CFR 1910.1000	Air Contaminants

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 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.

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.

Textured Wall Coating System; G

Sample Textured Wall Coating System Mock-Up; G

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings; G

SD-08 Manufacturer's Instructions

Application instructions;G

Mixing;G

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets;G

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:; G

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 similiar materials 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

1.4 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 conform 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 crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc 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, including the Activity Hazard Analysis as specified in Section 01 35 14.11 40 DRYDEN SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. 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 PA 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 0100Doc, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

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 LOCATION AND SURFACE TYPE TO BE PAINTED

1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.9.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.9.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces,andexisting coated surfaces of the building 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 . Other contiguous surfaces.

1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, 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.

1.9.3 Mechanical and Electrical Painting

Includes field coating of interior and exteriornew and existing 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.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.9.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

1.9.4 Exterior Painting of Site Work Items

Field coat the following items:

New Surfaces	
a. bollards to be traffic yellow	

1.9.5 Definitions and Abbreviations

1.9.5.1 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.

1.9.5.2 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.

1.9.5.3 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, calendaring, 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.

1.9.5.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.9.5.5 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.

1.9.5.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.9.5.7 EXT

MPI short term designation for an exterior coating system.

1.9.5.8 INT

MPI short term designation for an interior coating system.

1.9.5.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.9.5.10 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.

1.9.5.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.9.5.12 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 at 60 degrees	Units at 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).

1.9.5.13 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.

1.9.5.14 Paint

See Coating definition.

1.9.5.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.9.5.16 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, disintegrated coatings, 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-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the

application instructions of the paint manufacturer.

e. Previously painted surfaces damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

g. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

i. Edges of chipped paint shall be feather edged and sanded smooth.

j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

k. New, proposed coatings shall be compatible with existing coatings.

3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

3.2.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.2.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

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. ; 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/NACE No.3 /SSPC SP 12/NACE No.5 WJ-3.

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/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

3.3.3 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.4 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

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, Chalking, Grease, and Oil: Wash new and existing uncoated 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. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new , existing coated, 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 APPLICATION

3.5.1 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. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based

paints or using spray equipment with any paints.

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.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.5.2 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.

3.5.3 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.

3.5.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

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.

3.6 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.

3.7 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by ASME 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.

3.8 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.

3.9 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

-- End of Section --

SECTION 10 44 00

FIRE PROTECTION SPECIALTY
05/12

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 409	(2011; Errata 11-1) Standard on Aircraft Hangars

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Data

SD-02 Shop Drawings

Fire Curtain;G

Accessories

SD-03 Product Data;G

Fire Curtain;G

Accessories

Replacement Parts

SD-04 Samples

Aircraft cable;G

Accessories;G

SD-07 Certificates

Connection brackets;G

Manufacturer's Warranty with Inspection Tag

1.3 DELIVERABLES

1.3.1 Samples

Provide the following samples: One of the type of Fire Curtain being installed; one half-sized sample of the type of aircraft cable being installed; one sample of connection brackets and Accessories of each type being used.

Approved samples may be used for installation, with proper identification and storage.

1.4 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

1.5 WARRANTY

Guarantee that Fire Curtains are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than one year after completion.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items: Fabri-Lock Curtain Wall System by Smoke & Fire Prevention Systems,a Division of CC&C, Inc. or approved equal.

2.1 TYPES

Submit certificates that show Fire Curtain comply with local codes and regulations.

Provide Fire Curtain conforming to NFPA 409. .

Submit Manufacturer's Data for Fire Curtain required, detailing all related support cables, Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Provide all materials, labor, equipment, service, etc., necessary and incidental to furnish and complete the installation of integral fabric curtain boards as shown on the drawings and specified herein.

A. Fabric for FabriLock shall be woven as follows:
    Style: 7721 or equivalent
    Color: White
    Weave Pattern: Fancy
    Fabric Construction: Warp MDYarns 58 +/-2 ends/in ECDE 75 1/0 Fill XMDYarns 42 +/-2 picks/in ECDE 75 1/0
    Breaking Strength: Warp - 250 lbs/in minimum. Fill - 200 lbs/in minimum
    Elmendorf Tear Strength: Warp - 14 lbs minimum. Fill - 14 lbs minimum
    Weight: Uncoated - 8.0 +/-0.3 OSY, Coated - 9.5 +/-0.7 OSY
    Air Permeability: 1 cfm maximum

B.Thread used in hemming the FabriLock fabric shall be woven from the same material as the FabriLock fabric.

C.FabriLock tape shall be manufactured, using a slightly lighter weight fabric, with a heat resistant adhesive that will not penetrate the fabric. The tape fabric will be the same color as the FabriLock fabric with the same coating and testing results.

D.FabriLock frame shall be constructed of 1/2 inch electrical metallic tubing. Tubing shall be continuous at the top and bottom of the curtain board with verticals at 10'-0" intervals to stabilize the curtain board and hold the fabric taut. The frame shall be connected with set screw tees.

E.FabriLock fasteners used to support the curtain board shall be fabricated from tempered spring steel. FabriLock fasteners shall be driven onto the supporting structure and have steel teeth that dig into the member. FabriLock fasteners shall be located at either 24" o.c. or 36" o.c. as per drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A.Installation shall be performed by skilled technicians in accordance with manufacturer's instructions.

B.FabriLock curtain boards shall be located in accordance with architect's drawings. FabriLock curtain boards shall be installed true and plumb at parallel and perpendicular lines to the building walls.

C.EMT tubing shall be galvanized steel. All verticals, tees, and connectors shall be painted to match fabric color.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Testing

A.FabriLock fabric shall be tested for both flammability and smoke generation as follows:

UL Classified
FM Listed
ASTM E-84 NFPA 255 Tunnel Test
ASTM E-662 NFPA 258 Smoke Density Test
ASTM E-136 Base Substrate
NFPA #701 Large Scale Test
NFPA #701 Small Scale Test
New York State U.F.P. Building Code Combustion Product Toxicity

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Submit Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

SECTION 21 13 00.00 40

FIRE-SUPPRESSION SPRINKLER SYSTEMS
08/10

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 IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2004) Standard Definitions for Use in the Design of Steel Structures

ASME INTERNATIONAL (ASME)

ASME A112.18.1/CSA B125.1	(2011) Plumbing Supply Fittings
ASME B16.1	(2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.34	(2009; Supp 2010) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2012) Power Piping

ASTM INTERNATIONAL (ASTM)

ASTM A126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135/A135M	(2009) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A234/A234M	(2011a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A307	(2010) Standard Specification for Carbon

	Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B370	(2011; E 2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B749	(2003; R 2009) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C592	(2012) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

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

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2013) Standard for the Installation of Sprinkler Systems
NFPA 13E	(2010) Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
NFPA 291	(2013) Recommended Practice for Fire Flow Testing and Marking of Hydrants

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	(1982; Rev B; Notice 2 2009) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-STD-101	(1970; Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement
FS FF-S-325	(Basic; Int Amd 3; Notices 3, 4) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel

1.2 GENERAL REQUIREMENTS

Design Analysis and Calculationsand installation shall be in accordance with NFPA 13.

Records of Existing Conditions shall be submitted showing the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions shall be submitted in accordance with the paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Sprinkler Heads

Sprinkler Heads;G

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Aboveground Piping Materials
Piping Materials;G

Valves

Riser Alarm Equipment

Sprinkler Heads

Miscellaneous Materials
Supporting Elements

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-05 Design Data

Design Analysis and Calculations shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section.

Pressure Tests

System Operating Tests

Air Tests

Valve-Operating Tests

Drainage Tests

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section

01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

PART 2 PRODUCTS

2.1 GENERAL

Fire-protection system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or the Factory Mutual (FM APP GUIDE).

Products with UL label or seal or listing in UL 6, and products with FM label or listed in the FM APP GUIDE are acceptable fire-protection system materials and equipment. Materials and equipment furnished shall be compatible with existing system.

Equipment and Performance Data shall be submitted for fire protection sprinkler systems consisting of information on use life, system functional flows, safety features, and mechanical automated details.

2.2 ABOVEGROUND PIPING MATERIALS

2.2.1 Type BCS - Black Carbon Steel

Pipe (1/8 through 1-1/2 inches): Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A53/A53M, or ASTM A135/A135M, Type F furnace butt welded.

Pipe (2 through 8 inches), where indicated): Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M or ASTM A135/A135M, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B.

Pipe (10 inches and over): Schedule 30 black carbon steel conforming to ASTM A53/A53M, Type E (electric-resistance welded) or Type S (seamless)

Unions (2 inches and under): 300-pound per square inch gage (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard pipe couplings: Extra-heavy screwed black steel

Grooved pipe couplings (all sizes): 175-psig minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A183

Fittings (4 inches and under): 175-psig working pressure, cast iron, screwed, conforming to ASTM A126, Class A, and ASME B16.4

Fittings (6 inches and larger): 175-psig working pressure, cast iron, conforming to ASTM A126, Class A, screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1

Fittings (8 inches and under): Couplings shall be rolled-groove type or mechanical locking (push-on) type. Grooves for rolled-groove type shall be rolled only; cut grooving will not be allowed. Rolled grooves shall be dimensionally compatible with the couplings.

Grooved fittings (all sizes): 175-psig working pressure fittings used with grooved couplings shall be fabricated of black malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A234/A234M and ASME B16.9.

2.3 SUPPORTING ELEMENTS

Piping system components and miscellaneous supporting elements shall be provided, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, piping material, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

Supporting elements shall be FM approved or UL listed and shall conform to ASME B31.1, MSS SP-58, and ASME B16.34.

2.3.1 Building-Structure Attachments

2.3.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325:

Group I: Shield, expansion (lead, bolt, and stud anchors)

Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

Group III: Shield, expansion (self drilling tubular expansion shell bolt anchors

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support mechanical-systems components.

2.3.1.2 Beam Clamps

Beam clamps shall be center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products.

Type 20 beam clamps shall be used for pipe 2 inches and under.

Two Type 25 beam clamps shall be used per point of pipe support.

2.3.1.3 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of MSS SP-58 for Type 18 and ASME B16.34. When applied to piping in sizes 2-inch iron pipe size (ips) and larger, and where otherwise required by imposed loads, a 1-foot length of 1/2-inch reinforcing rod shall be inserted and wired through wing slots.

2.3.2 Horizontal-Pipe Attachments

2.3.2.1 Single Pipes

Piping in sizes up to and including 2-inch ips shall be supported by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Piping in sizes 2-1/2 inches and larger shall be supported by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.3.2.2 Parallel Fire-Protection Pipes

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used when so specified. Structural-steel shapes shall conform to supplementary steel requirements or the support shall be of commercially available, approved proprietary-design rolled steel.

2.3.3 Vertical-Pipe Attachments

Single vertical-pipe attachments shall be Type 8.

2.3.4 Hanger Rods and Fixtures

Only circular solid cross section rod hangers shall be used to connect building structure attachments to pipe-support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.3.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC/AISI 121.

2.4 RISER ALARM EQUIPMENT

Riser alarm equipment shall be UL listed or FM approved for fire-protection use.

2.4.1 Wet-Pipe Alarm Check Valve

Wet-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm and shall include pressure gages, retard chamber, testing provisions, and all necessary intercomponent piping, fittings, and valves. Pilot valve and clapper shall have individual elastomer seats.2.4.2 Water-Flow Alarm Device

Water-flow alarm devices shall be UL listed for the particular type of system.

2.4.2.1 Pressure Switch Remote Alarm

Pressure switch shall be wired to make or break a circuit depending on rise or fall of water pressure.

2.4.2.2 Vane-Type Flow Alarm

Vane-type flow alarm shall make or break an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Alarm shall have an instant-recycle pneumatic-retard time delay.

2.5 SPRINKLER HEADS

2.5.1 Head Types

Standard 1/2-inch orifice sprinkler heads shall be used.

Heads in finished areas below suspended ceilings shall be flush chrome-plated brass. Escutcheon plate shall be baked enamel finished to match ceiling.

Heads in finished areas below suspended ceiling shall be flush or pendent type. Heads and escutcheon plates shall be chrome-plated brass.

Heads in unfinished areas below suspended ceilings shall be pendent type. Heads in all other locations shall be upright type.

Corrosion-resistant heads shall be lead-coated.

2.5.2 Temperature Rating

Fusible links shall be intermediate temperature, except where otherwise indicated.

2.5.3 Spares

Spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.5.4 Head Protection

Heads shall be protected with paper or plastic bags during painting operations. Protection shall be removed immediately upon finishing painting operations.

Head guards shall be provided wherever mechanical damage could occur. Guard finish shall be red enamel.

2.6 VALVES

2.6.1 Aboveground

Gate, globe, and check valves (all sizes) shall be FM approved or UL listed.

Ball valves, 2 inches and under, shall be FM approved, rated 300 psi, with provisions to wire or lock handle in place where critical alarm function may be isolated.

Butterfly valves, 6-, 8-, and 10-inch shall be FM approved, rated 175 psi, cast-iron bodied wafer type, with elastomer liners and seals. Liners shall act as gasket between standard piping-system flanges. Operator shall be worm-gear type, with permanently lubricated gears, and oiltight and watertight case, complete with handle and automatic position indication.

2.7 MISCELLANEOUS MATERIALS

2.7.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat and shall be as recommended by the conduit manufacturer for compatibility with factory coating and rubber joints.

For previously coal-tar-coated and for uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to MIL-C-18480.

2.7.2 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM A307, Grade B. Heavy hex-nuts shall conform to ASTM A563. Square-head bolts and nuts are not acceptable.

2.7.3 Elastomer Caulk

Polysulfide- or polyurethane-base elastomer-caulking material shall be two-component type, conforming to ASTM C920.

2.7.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated, except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.18.1/CSA B125.1.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.7.5 Flashing

2.7.5.1 Lead

Sheet lead shall conform to ASTM B749, and shall weigh not less than 4 pounds per square foot.

2.7.5.2 Copper

Sheet copper shall conform to ASTM B370 and shall weigh not less than 16 ounces per square foot.

2.7.6 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.7.7 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.8 FIRE-PROTECTION SYSTEM IDENTIFICATION

A coordinated system of piping and equipment identification shall be provided which includes the following:

Framed and plastic-protected diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves. Where existing systems are being modified, existing layouts shall be brought up to date.

Metal-tag-identified major valves, piping-system components, and equipment

Metal identification plate at controlling alarm valve identifying system and area protected

Service-labeled piping

Color coding shall be used for flow-capacity identification of fire hydrants only. Color coding shall be in accordance with NFPA 291. Numbering of post-indicator valves, hydrants, and other components shall be an extension of existing systems.

2.8.1 Diagrams

Chart listing of equipment shall be by designation number and shall show pertinent data. Diagrams shall be neat, mechanical drawings mounted in extruded aluminum frames, with 1/8-inch thick acrylic plastic protection. Location shall be as directed by the Contracting Officer. A minimum of one mounted chart and diagram, plus one extra copy of each, shall be provided for each fire-protection system.

2.8.2 Metal Tags

Identification tags made of brass or aluminum and indicating function of valve or similar component, shall be installed on such system devices. Tags shall be not less than 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags bearing an equipment designation number matching the drawing or diagram designations.

Tags shall be secured to valve or equipment items with 12-gage galvanized wire.

2.8.3 Service Labeling

Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designations shall be as follows:

SERVICE	LABEL OR TAG DESIGNATION
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH

SERVICE	LABEL OR TAG DESIGNATION
Standpipe piping	STANDPIPE

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit through walls

Each change in direction

In congested or hidden areas, at each point required to clarify service or indicate hazard

In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 40 feet.

Label lettering shall be 2 inches high. Where the size of pipes is 2-1/2-inch outside diameter and smaller, labels shall be attached to 16-gage aluminum sheet which shall be attached to the pipe with 12-gage galvanized wire. Labels shall be legible from the primary service and operating area.

Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background.

Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.

2.9 PAINTING

Equipment of the manufacturer's standard product shall be furnished with the manufacturer's standard finish coat.

Other mechanical equipment shall be furnished with a shop-applied prime paint.

PART 3 EXECUTION

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 13 and NFPA 13E. Work shall be performed in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of the start of work.

All installation work shall be performed by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

3.2 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel shall be arranged to be

in line with each other and parallel to the lines of the building.

Load rating for pipe-hanger supports shall be based on all lines filled with water. Deflection per span shall not exceed slope gradient of pipe. Schedule 40 and heavier ferrous pipe supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, allowable span shall be reduced proportionately.

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	HANGER SPACING FOR STEEL PIPE (FEET)
Up to 1	3/8	8
1-1/4	3/8	12
1-1/2	3/8	15
2-1/2 to 3-1/2	3/8	15
5	1/2	15
6	1/2	15
8	1/2	15

Vertical risers shall be supported at the base where possible and at intervals specified. Piping shall be guided for lateral stability as necessary. Clamps shall be placed under fittings wherever possible. Carbon-steel pipe shall be supported at each floor at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

Piping shall be securely supported with allowance for thrust forces and thermal expansion and contraction and shall not be subject to mechanical, chemical, vibrational, or other damage, in conformance with ASME B31.1.

3.3 SOUND STOPPING

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts, and large floor and wall openings may be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, only mineral fiber shall be used, and, in addition, openings shall be covered with 16-gage sheet metal.

3.4 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, or floors.

Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers shall be continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally shall provide a minimum 3/8-inch clearance. Sleeve shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Space between a pipe and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with mineral fiber conforming to ASTM C592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration shall be filled with an elastomer caulk to a depth of 1/2 inch. Surfaces to be caulked shall be oil- and grease-free.

Exterior wall sleeves shall be caulked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.5 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. Escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Escutcheons shall be firmly attached.

3.6 FLASHINGS

Flashings at systems penetrations of building boundaries shall be provided as indicated.

3.7 BRANCH-LINE TESTERS

Branch-line testers shall permit testing and flushing lines without shutdown of system or loss of fire-protection capability. Line testers shall be fitted with chain-attached caps.

Line testers shall be installed where indicated and on most remote branch lines being served by cross mains, so that testing may be accomplished at the dead corners of each sprinkler system.

3.8 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Government.

Pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All firex piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles and siamese connections, shall receive two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.9 ELECTRICAL WORK

Electrical work is specified in DIVISION 26 ELECTRICAL except for control and fire alarm wiring which shall be provided under this section in accordance with NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except that electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Controllers and contactors shall have maximum 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment are furnished larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

3.10 SYSTEM TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer. Upon approval, certificates of testing shall be provided.

Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing.

Air Tests, Valve-Operating Tests, and Drainage Tests shall be performed for dry-pipe systems.

Full-flow System Operating Tests shall be performed for standpipe systems.

Government will supply testing water at a location determined by the Contracting Officer, but the Contractor shall be responsible for approved disposal of contaminated water.

Contractor shall prepare and maintain test records of piping-system tests. Records shall show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance

shall require the signature of the Contracting Officer.

3.10.1 Test Gages

Test gages, to be acceptable, shall have 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, test gage number, and the project number.

3.10.2 Pneumatic Testing

Pressure Tests shall be pneumatic when freezing conditions may occur and upon prior approval by the Contracting Officer. Compressed air used for testing shall be oil-free.

Pneumatic testing shall include swabbing all joints under a test pressure of 5 psig with a standard high film strength soap solution and observing for bubbles.

Duration of the test will be determined by the Contracting Officer and will be for 2 hours, minimum, to 24 hours, maximum. Test may be terminated by direction of the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

3.10.3 Test and Acceptable Criteria

Aboveground systems shall have Pressure Tests at 200 psi and the applied pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop shall be 2 psi.

Dripping or weeping joints shall be repaired.

3.11 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, at which time the solution shall contain a minimum residue of 2 ppm of available chlorine or the system shall be re-disinfected. After successful disinfection the piping shall be thoroughly flushed before placing into service. Water for disinfection, and flushing will be furnished by the Government.

3.12 CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. Equipment, pipes, valves, and fittings shall be

cleaned of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Automatic control devices shall be adjusted for proper operation.

-- End of Section --

SECTION 21 13 18.00 10

PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION
05/09

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.

ASME INTERNATIONAL (ASME)

ASME B16.1	(2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11	(2011) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(2010) Standard for Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A135/A135M	(2009) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A449	(2010) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings

ASTM A795/A795M	(2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM F436	(2011) Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

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

MSS SP-71	(2011) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2013) Standard for the Installation of Sprinkler Systems
NFPA 24	(2013) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code
NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS WW-S-2739	(Basic; Notice 1) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2012) Building Materials Directory
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

b. Provide preaction sprinkler system(s) in areas indicated on the drawings . The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall meet the requirements of NFPA 13, NFPA 409 and NFPA 72. The sprinkler system shall be a single interlocked system that requires the actuation of an alarm initiating device to open the water control (deluge) valve.

c. Design any portions of the sprinkler system that are not indicated on the drawings or are not specified herein, including locating sprinklers, piping, and equipment, and size piping and equipment. Determine pipe sizes which are not indicated on the drawings by hydraulic calculations.

1.2.1 Hydraulic Design

Hydraulically design the system to discharge a minimum density of 0.17 gpm/square foot over the hydraulically most demanding 15,000square feet of floor area. The minimum pipe size for branch lines in systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13.

1.2.1.1 Hose Demand

Add an allowance for exterior hose streams of 500 gpm to the sprinkler system demand at the point of connection to the existing water system. An allowance for interior hose stations of 60 gpm shall also be added to the sprinkler system demand.

1.2.1.2 Basis for Calculations

Base the design of the system upon fire pumps rated at 145 psi at 12,000 gpm with a maximum shutoff pressure of 160 psi to be located at Building 4853. Base hydraulic calculations on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS.

a. Outline hydraulic calculations as in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically.

b. Plot water supply curves and system requirements on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Indicate elevations of hydraulic reference points (nodes). Documentation shall identify each

pipe individually and the nodes connected thereto. Indicate for each pipe the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient.

1.2.2 Sprinkler Coverage

Uniformly space sprinklers on branch lines. In buildings protected by automatic sprinklers, provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13 and NFPA 409, but shall not exceed 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies, and 225 square feet for light hazard occupancies.

1.2.3 Control System

The control system shall meet the requirements of NFPA 72. The control panel shall be listed in UL Fire Prot Dir or FM APP GUIDE for "Releasing Device Service". The control panel and the solenoid valve that activates the water control valves shall be compatible with each other. Compatibility shall be in accordance with specific UL listing or FM approval of the control equipment.

1.2.3.1 Power Supply

Provide the primary operating power from two single-phase 120 VAC circuits. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and shall not initiate a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Provide backup power through use of rechargeable, sealed, lead calcium storage batteries.

1.2.3.2 Circuit Requirements

Connect alarm initiating devices to initiating device circuits (IDC), Style D or to signal line circuits (SLC), Style 6 , in accordance with NFPA 72. Alarm notification or indicating appliances shall be connected to indicating appliance circuit (IAC), Style W in accordance with NFPA 72. Provide a separate circuit for actuation of each individual automatic water control valve. Fully supervise the circuits that actuate the water control valves so that the occurrence of a single open or a single ground fault condition in the interconnecting conductors will be indicated at the control panel.

1.2.4 System Operational Features

Include in the system a heat detection system, manual actuation stations, supervisory and alarm switches, alarm notification appliances, control panel and associated equipment. Provide preaction sprinkler system piping with supervisory air pressure not to exceed 30 psig.

1.2.4.1 System Actuation

Activation of any 2 heat detectors or a single manual actuation station shall actuate alarm zone circuits of the control panel that, in turn, shall actuate the corresponding automatic water control valve. Actuation of the automatic water control valve shall cause water to fill the preaction system piping and be discharged from fused sprinklers .

1.2.4.2 Alarm Functions

Activation of any heat detector or sprinkler pressure alarm switch or manual actuation station shall cause activation of the building fire alarm system and transmission of the alarm to the base-wide fire reporting system. Valve tamper alarm shall be monitored by the system control panel and transmitted to the building fire alarm system as a trouble alarm.

1.2.4.3 Supervisory Functions

The reduction of supervisory air pressure within the sprinkler system piping to less than 10 psi or the occurrence of a single open or a single ground fault in any alarm initiating device circuit, in the automatic water control valve actuation circuit, in any alarm indicating appliance circuit or in other electrically supervised circuit shall cause the individually labelled control panel trouble light to be illuminated, the audible trouble alarm to be activated, and a trouble alarm to be transmitted to the building fire alarm control panel and to base-wide fire reporting system.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G
As-Built Drawings; G

SD-03 Product Data

Fire Protection Specialist; G
Installer Qualifications
List of Submittals
Materials and Equipment; G
Spare Parts
OnSite Training; G

SD-05 Design Data

Sway Bracing; G
Hydraulic Calculations; G

SD-06 Test Reports

Preliminary Tests; G
Final Acceptance Tests; G

SD-07 Certificates

Inspection by Fire Protection Specialist; G

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

1.4 QUALITY ASSURANCE

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. Applicable material and installation standards referenced in Appendix A of NFPA 13 shall be considered mandatory the same as if such referenced standards were specifically listed in this specification. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Incorporate all requirements that exceed the minimum requirements of NFPA 13 into the design. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Fire Protection Specialist

Perform the work specified in this section under the supervision of and certified by the Fire Protection Specialist (FPS) who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers. Submit the name and documentation of certification of the proposed FPS, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations. The FPS shall prepare and submit a list of submittals, related to fire protection, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s), no later than 7 days after the approval of the FPS. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the FPS when submitted to the Government. The FPS shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.2 Installer Qualifications

Work specified in this section shall be performed by the Sprinkler System Installer. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the FPS Qualifications. The Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Shop Drawings

Submit 3 copies of the Sprinkler System Drawings, on reproducible full-size mylar film, no later than 21 days prior to the start of sprinkler system installation. The drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Update the Shop

Drawings to reflect as-built conditions after all related work is completed. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1/8" = 1'-0" which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Indicate each type of fitting used and the locations of bushings, reducing couplings, and welded joints.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

f. Complete point-to-point wiring diagram of the detection and control system. Indicate the detailed interconnection of control panel modules to the devices, the number and size of conductors in each conduit, and size of conduit. Connection points shall be indicated and coordinated with the terminal identification marked on the devices. Provide complete internal wiring schematic of the control panel and each electrical device. Detailed description of the functions of the control panel and each module shall be provided.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include alist of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. Highlight the data to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.4 ABOVEGROUND PIPING COMPONENTS

2.4.1 Steel Pipe

Except as modified herein, steel pipe shall be black Schedule 40as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A795/A795M, ASTM A53/A53M, or ASTM A135/A135M. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.4.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.4.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gaskets shall be of silicon compound and approved for dry fire protection systems. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.4.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

2.4.4.1 Bolts

Bolts shall be ASTM A449, Type 1. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.4.4.2 Nuts

Nuts shall be hexagon type conforming to ASME B18.2.2 .

2.4.4.3 Washers

Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.4.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and size to be supported.

2.4.6 Duplex Basket Strainers

FS WW-S-2739, Style Y (Y pattern). Provide duplex basket strainers with removable screens having standard perforations, 0.125 inch in diameter in the riser upstream of the deluge valves.

2.4.7 Valves

2.4.7.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.

2.4.7.2 Check Valves

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5 AUTOMATIC WATER CONTROL VALVE (DELUGE VALVE)

Automatic water control valve (deluge valve) shall be electric/pneumatic -actuated and rated for a working pressure of 175 psi. Valve shall be capable of being reset without opening the valve. Electrical solenoid valve used to actuate the water control valve shall be an integral component of the valve or shall be approved for use by the water control valve manufacturer. Solenoid valve shall be rated at 24 volts direct current, and shall be normally closed type that operates when energized. Solenoid valves shall be rated for a maximum pressure differential of 175 psi. Water control valve shall be equipped with a means to prevent the

valve from returning to the closed position until being manually reset. Assembly shall be complete with the valve manufacturer's standard trim piping, drain and test valves, pressure gauges, and other required appurtenances. Include with each assembly an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation. Valves located in hazardous locations shall be approved for the hazard classification of the area where located.

2.6 SUPERVISORY AIR SYSTEM

2.6.1 Air Compressor

Air compressor shall be single stage oil less type, air cooled, electric-motor driven, equipped with a check valve, centrifugal pressure and moisture unloader, pressure switch for automatic starting and stopping. Pressure switch shall be set to start the compressor at 20 psi and stop it at 30 psi. A safety relief valve, set to operate at 65 psi, shall be provided. The compressor shall be sized to pressurize the system to 30 psi within 30 minutes.

2.6.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air pressure to the minimum pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1/16 inch restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing maximum inlet pressure of 100 psi to a fixed outlet pressure adjustable to 10 psi.

2.6.3 Air Supply Piping System

Each preaction system shall be equipped with a separate pressure maintenance device, shutoff valve, bypass valve and pressure gauge.

2.6.4 Low Air Pressure Switch

Each preaction system shall be provided with an air pressure switch connected to the control panel. Upon reduction of supervisory air pressure to approximately 10 psi, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light on the control panel annunciator.

2.7 SPRINKLERS

Sprinklers for preaction systems shall be automatic, fusible solder or glass bulb type. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be intermediate. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

2.7.1 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, recessed

quick-response type with nominal 1/2 inch orifice. Pendent sprinklers shall have a polished chrome finish.

2.7.2 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 1/2 inch orifice.

2.7.3 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the upright type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.8 ACCESSORIES

2.8.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.8.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.8.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.8.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated or located below 7'0" above finished floor.

2.8.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.9 CONTROL PANEL

Refer to Specification 28 31 64.00 10 and drawings for additional information.

2.9.1 Primary Power Supply

Primary power and trouble alarm power to the Control Panel shall be supplied from two 120 VAC circuits. Power to the control panel shall be as

indicated.

2.10 ALARM INITIATING DEVICES

2.10.1 Heat Detectors

Detectors located in areas subject to moisture, exterior atmospheric conditions or hazardous locations as defined in NFPA 70 shall be approved for such locations. Detectors shall be listed or approved for 50 foot spacing between detectors. The detector shall be equipped with an alarm indicating light in its base that lights when the detector is in an alarm condition. Five spare detectors of each type and temperature rating shall be provided.

2.10.1.1 Rate Compensation Detector

Detector shall be of the vertical or horizontal spot type with a temperature classification rating of intermediate as defined by NFPA 72. Detectors listed or approved as "rate anticipation" type will be accepted. Detector shall automatically reset when temperature drops below detector temperature rating. Detector shall be hermetically sealed.

2.10.1.2 Fixed-Temperature Heat Detector

Detector shall have a fusible alloy that will melt and cause an alarm when the surrounding air rises above the temperature rating of the detector. The detector shall provide an external indication upon actuation of the detector. Detector shall provide a temperature classification rating of intermediate as defined by NFPA 72.

2.10.2 Manual Actuation Station

Station shall be mounted at 42 inches above the floor, unless otherwise shown. Station shall be arranged to activate the deluge system. Station shall be dual-action type requiring two separate operations in order to cause system discharge. Station shall be colored a unique color dissimilar to color used for manual fire alarm system. Station shall be provided with a positive visible indication of operation of the station. Station shall be weatherproof type and shall be provided with an engraved label indicating PREACTION SYSTEM.

2.10.3 Sprinkler Pressure Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches. The switch shall have a service pressure rating of 175 psi. There shall be two SPDT (Form C) contacts factory adjusted to operate at 4 to 8 psi. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.10.4 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.11 WIRING

Wiring for alternating current (AC) circuits shall be 12 AWG minimum.

Wiring for low voltage direct current (DC) circuits shall be No. 16 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in electrical metallic tubing or in metallic conduit, except rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same function shall be similarly color coded. Wiring color code shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, alarm indicating, supervisory, and actuation circuits are prohibited.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of publications referenced herein.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements, including signed approval of the Preliminary, Detection and Control Systems, and Final Acceptance Test Reports. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Protection of Piping Against Earthquake Damage

Seismically protect the system piping against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping, including sway bracing as required, in accordance with NFPA 13 and Annex A; submit load calculations for sizing of sway bracing for systems that are required to be protected against damage from earthquakes. Include the required features identified therein that are applicable to the specific piping system.

3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed

spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers Locations

Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into a branch line tee. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches for steel pipe. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

3.4.6 Pendent Sprinklers Locations

Sprinklers installed in the pendent position shall be of the listed dry pendent type, unless otherwise indicated. Dry pendent sprinklers shall be of the required length to permit the sprinkler to be threaded directly into a branch line tee. Hangers shall be provided on arm-overs exceeding 12 inches in length. Dry pendent sprinkler assemblies shall be such that sprinkler ceiling plates or escutcheons are of the uniform depth throughout the finished space. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.7 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer. 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.

3.4.8 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where

used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.4.9 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve in accordance with NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.10 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.11 Drains

Provide main drain piping to discharge at the location indicated. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 3 gallons, the auxiliary drain shall consist of a valve not smaller than 1/2 inch and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 3 gallons, the auxiliary drain shall consist of two 1 inch valves and one 2 x 12 inch condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 1 inch in diameter. Tie-in drain lines shall be pitched a minimum of 1/2 inch per 10 feet.

3.4.12 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 ELECTRICAL WORK

Unless otherwise specified herein, power supply equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.5.1 Overcurrent and Surge Protection

All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1, IEEE C62.41.2 and NFPA 70. Cables and conductors that serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses

shall not be used for surge protection.

3.5.2 Grounding

Grounding shall be provided to building ground.

3.5.3 Wiring

System field wiring shall be installed in 3/4 inch minimum diameter electrical metallic tubing or metallic conduit. Wiring for the sprinkler system fire detection and control system shall be installed in tubing or conduits dedicated for that use only and not installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts. Conductors shall be color-coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel.

3.5.4 Detectors

Detectors shall be ceiling-mounted in accordance with NFPA 72 and 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.

3.5.5 Manual Actuation Stations

Manual actuation stations shall be mounted readily accessible and 42 inches above the finished floor.

3.6 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 PRELIMINARY TESTS

The system, including the underground water mains, the aboveground piping, detectors and control system and system components shall be tested to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests, proposed date and time to begin the tests, submitted with the Procedures. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, complete and submit certificates as specified, and 3 copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Report shall include both the Contractor's Material and Test Certificate

for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

3.7.1 Aboveground Piping

3.7.1.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.7.1.2 Air Pressure Test

As specified in NFPA 13, an air pressure leakage test at 50 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

3.7.2 Detection and Control System Tests

Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. The control system tests specified in paragraph FINAL ACCEPTANCE TESTS shall be conducted to ensure that the system is completely functional and that wiring has been properly connected. If deficiencies are found, corrections shall be made and the system shall be retested to assure that the systems have no deficiencies.

3.7.3 Automatic Water Control Valve Test

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector and a manual actuation station connected to the control panel and a manual actuation device that is part of the valve trim. A full-flow main drain test shall be made. For preaction systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.

3.8 FINAL ACCEPTANCE TESTS

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test; submit the proposed procedures for Final Acceptance Tests, no later than 14 days prior to the proposed start of the tests, the proposed date and time to begin Final Acceptance Tests, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test

shall be repeated to assure that control valves are in the open position. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. Submit 3 copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Report shall be signed by the Fire Protection Specialist In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. Submit as-built drawings, at least 14 days after completion of the Final Tests. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed.

3.8.1 Control System Test

Testing shall be in accordance with NFPA 72. The test shall include the following:

a. Visual inspection of wiring connections.

b. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.

c. Test of each function of the control panel.

d. Test of each circuit in the normal, open and ground fault modes.

e. Test of each initiating device in both normal and trouble conditions.

f. Test of each control circuit and device.

g. Test of each alarm notification appliance.

h. Test of the battery charger and batteries.

i. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

3.8.2 Trip-tests of Automatic Water Control Valves

Each water control valve shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective heat detector, a manual actuation station connected to the system control panel and the manual release which is part of the valve trim. Each valve shall be returned to normal condition after each test. Prior to trip testing sprinkler deluge system, precautionary steps shall be taken to prevent water damage to the building and equipment from sprinkler discharge. Control valves on preaction systems shall remain open until piping is filled with water.

3.8.3 Tests of Supervisory Air System

Preaction system supervisory air pressure shall be reduced from the normal

system pressure to the point at which a low-pressure alarm is sounded. Air pressure shall be restored to verify trouble signal restoration. Automatic start/stop features of air compressor shall be tested.

3.9 ONSITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed Onsite Training schedule, at least 14 days prior to the start of related training. Training shall be provided for a period of four hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit 6 two hard copies and one electronic copy ofmanuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days 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.

-- End of Section --

SECTION 21 13 20.00 20

FOAM FIRE EXTINGUISHING FOR AIRCRAFT HANGARS
11/09

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11	(2010; TIA 10-1) Standard for Low-, Medium- and High- Expansion Foam
NFPA 13	(2013) Standard for the Installation of Sprinkler Systems
NFPA 24	(2013) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 22	(1982; E 2004) Paint Specification No. 22 Epoxy-Polyamide Paints (Primer, Intermediate, and Topcoat)

SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 11	(1987; E 2004) Power Tool Cleaning to Bare Metal
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441	(2009; Rev D) Paint, Epoxy-Polyamide, General Specification for
ETL 02-15	(2002) Engineering Technical Letter ETL 02-15: Fire Protection Engineering Criteria - New Aircraft Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-2962	(Rev A; Notice 2) Enamel, Alkyd, Gloss, Low VOC Content
CID A-A-58092	(Basic; Notice 1) Tape, Antiseize, Polytetrafluoroethylene
FS WW-S-2739	(Basic; Notice 1) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

Design for the removal of the existing foam systems and provide a new high expansion foam system for the entire hangar floor. System shall provide complete coverage throughout the areas indicated. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 11, NFPA 13, NFPA 24, NFPA 70, NFPA 72, ETL 02-15 and NFPA 409, except as modified herein. Each system shall be designed for earthquakes and shall include all materials, accessories and equipment necessary to provide each system complete and ready for use. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to provide complete coverage in

accordance with the drawings to be submitted for approval. Devices and equipment for fire protection service shall be of a make and type listed by the Underwriter's Laboratories Inc. in the UL Fire Prot Dir, or approved by the Factory Mutual System and listed in FM APP GUIDE. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Contracting Officer. Begin work at the point indicated.

1.3.1.1 Shop Drawings

Prepare shop drawings for fire extinguishing system in accordance with the requirements for "Plans" as specified in NFPA 11 and "Working Plans" as specified in NFPA 13. Each drawing shall be 34 by 22 inches. Do not commence work until the design of each system and the various components have been approved. Show:

a. Room, space or area layout and include data essential to the proper installation of each system

b. Foam generators and system piping layout annotated with reference points for design calculations

c. Field wiring diagrams showing locations of devices and points of connection and terminals used for all electrical field connections in the system, with wiring color code scheme

.

1.3.1.2 Calculations

Submit design calculations for the system.

a. Hydraulic calculations showing basis for design in accordance with NFPA 11, ETL 02-15, NFPA 409 and NFPA 13.

b. Pressure discharge graphs or tables showing pressure discharge relationship for sprinkler heads and discharge nozzles.

1.3.1.3 As-Built Drawings for the Fire Extinguishing System

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings for the fire extinguishing system , including complete as-built circuit diagrams,. Submit 34 by 22 inch reproducible as-built drawings on mylar film with 8 by 4 inch title block similar to contract drawings. Submit as-built drawings in addition to the record drawings required by Division 1.

1.3.2 System Operation

Flow of water and high expansion foam shall be controlled by deluge valves with pilot regulating trim. Foam proportioning equipment shall activate automatically upon tripping of the deluge valve(s) for the corresponding foam system(s). Deluge valves shall be tripped by independent detection

systems. System shall be capable of shutting off after operation via abort switches. Provide separate circuits from the control panel to each zone of initiating devices. Transmission of signals from more than one zone over a common circuit is prohibited.

1.3.2.1 Overhead Systems

Overhead systems shall be controlled by deluge valves operated by automatic detection systems and by remote manual release stations.

1.3.2.2 Foam Generators

Foam generators shall be controlled by deluge valves operated by the automatic detection systems and manual release stations .

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 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire extinguishing system; G

SD-03 Product Data

Pipe, fittings, and mechanical couplings; G

Deluge valves; G

Valves, including gate, check, and globe; G

Foam Generators; G

Pipe hangers and supports; G

Pressure switch; G
Alarm bells; GTrouble Alarm ; G
Horizontal Bladder Tanks; G

Proportioning equipment; G

Foam concentrate; G

Strainers; G

Manual release stations; G

Abort stations; G

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit only originals. Photocopies will not be accepted. Partial submittals will not be accepted.

SD-05 Design Data

Hydraulic calculations; G

Pressure discharge graphs or tables; G

SD-06 Test Reports

Preliminary tests; G

Acceptance tests; G

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

Hydrostatic testing of the diaphragm pressure proportioning tanks; G

SD-07 Certificates

Qualifications of installer; G

Submit installers qualifications as required under paragraph entitled Qualifications of Installer."

SD-10 Operation and Maintenance Data

Deluge valves, Data Package 3; G

Proportioning equipment, Data Package 3; G

Concentrate storage tanks, Data Package 3; G

Foam Generators, Data Package 3; G

Instructions for operating the fire extinguishing system, Data Package 4; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Furnish one complete set of data prior to the time that final acceptance tests are performed, and furnish the remaining sets before the contract is completed.

SD-11 Closeout Submittals

As-built drawings for the fire extinguishing system; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Installer

Prior to commencing work, submit data showing that the Contractor has successfully installed automatic foam fire extinguishing sprinkler systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having the required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system, and certify that the

system has performed satisfactorily for a period of at least 18 months.

Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in Special Hazard System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

1.6 SPARE PARTS

Furnish the following spare parts:

a. 2 of each type of fuse required by the system.

b. 5 complete sets of system keys.

PART 2 PRODUCTS

2.1 DESIGN OF FOAM SYSTEMS

Design of deluge fire extinguishing foam systems shall be by hydraulic calculations for uniform distribution of 2% high expansion foam solution over the protected area and shall conform to the NFPA and ETL standards listed above and to the requirements as specified herein.

2.1.1 Deluge Valves

Valves shall be operated by a detection system listed for releasing service and connected to the building fire alarm system. Deluge valve shall be a quick opening, differential type flood valve with a spring loaded rolling diaphram clapper. Provide pilot regulating trim. In addition to automatic operation, arrange each valve for manual release at the valve. Provide pressure gauges and other appurtenances at the deluge valves as required by NFPA 13. Provide a detection device at the end of each actuation circuit to test the circuit and mount the device adjacent to the valve between 6 and 8 feet above the finish floor. Label each testing device to indicate the valve it activates. Provide remote manual releases where shown.

2.1.2 Foam Rate of Application

System to provide the specified quantity of 2% high expansion foam covering areas per NFPA 409 and ETL. The minimum rate of discharge shall be greater than 2.6 ft3min/ft2.

2.1.3 Friction Losses

Calculate losses in pipe in accordance with the Hazen-Williams Formula with 'C' value of 100 for steel pipe in normally non-water filled pipe, 120 for water filled steel pipe, 150 for copper tube, and 140 for cement lined ductile iron pipe.

2.1.4 Water Supply

Base hydraulic calculations on 3 fire pump(s) running. Provide fire pumps as specified in Section 21 30 00 FIRE PUMPS.

2.1.5 Duration of Discharge

System shall discharge foam solution through foam generators for a minimum of 15 minutes. Reduction of the discharge duration based on a discharge rate higher than the specified minimum is not permitted.

2.2 MANUAL RELEASE STATIONS

Provide foam generatorrelease stations where shown. Stations shall be of a type not subject to operation by jarring or vibration. Manual foam discharge stations must be yellow and distinctively different from the manual fire alarm stations, and will have distinctive signage at each device stating “START FOAM SYSTEM” in red lettering not less than 76 millimeters (3 inches)high on a yellow or lime-yellow background. The manual foam discharge station must be mounted directly on the sign. Manual foam discharge stations must be housed within a clear plastic tamper cover that must be lifted prior to actuating the station. Any colored portions of the tamper covers must be yellow and any lettering on the cover must be “FOAM”; the words “fire” or “fire alarm” will not appear on the cover. Station shall provide positive visible indication of operation. Restoration shall require use of a key or special tool. Stations shall be weatherproof type.

2.3 ABORT STATIONS

Provide foam generator abort stations where shown. Stations shall be of a type not subject to operation by jarring or vibration. Stations shall be installed adjacent to each manual releasing station and be properly labeled (Minimum 1½ inch high lettering stating: "CONTINUOUS OPERATION OF SWITCH WILL ABORT FOAM FLOW UNTIL SYSTEM IS RESET". Switch shall be deadman type which when depressed ceases flow of foam solution (both water and foam concentrate). Upon release of the switch, the system shall return to its previous operational state. Switch and wiring shall be supervised.

2.4 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE .

2.4.1 Wiring

Provide control wiring and connections to fire alarm systems, under this section and conforming to NFPA 70 and NFPA 72. Wire for 120 volt circuits shall be No. 12 AWG minimum solid conductor. Wire for low voltage DC circuits shall be No. 16 AWG minimum solid conductor , except wire to remote annunciators, if provided, may be 18 AWG minimum solid conductor. All wiring shall be color coded. Wiring, conduit and devices exposed to water or foam discharge shall be weatherproof. Wiring, conduit and devices located in hazardous atmospheres, as defined by NFPA 70and as shown, shall be explosion proof. All conduit shall be minimum 3/4 inch size.

2.4.2 Operating Power

Power shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal, and actuating (releasing) circuits. Provide secondary DC power supply for operation of

system in the event of failure of the AC supply. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Obtain AC operating power for control panel, battery charger , and air compressor from the line side of the incoming building power source ahead of all building services. Provide independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for these connections and locate adjacent to the main distribution panel. Paint switch box red and suitably identify by a lettered designation.

2.4.3 Conductor Identification

Identify circuit conductors within each enclosure where a tap, splice or termination is made. Identify conductors by plastic coated self sticking printed markers or by heat-shrink type sleeves. Attach the markers in a manner that will not permit accidental detachment. Properly identify control circuit terminations.

2.5 SYSTEM ACTIVATION

2.5.1 Generator System Activation

Each zone shall encompass the generators indicated. Upon activation of detectors for the overhead system or activation of a manual release station, all generators in that zone shall be activated.

2.6 ALARMS

2.6.1 Local Alarm

Provide electric alarm bells to sound locally on operation of any system, regardless of whether water flows or not. When more than one alarm is provided, provide permanent engraved rigid plastic or metal signs indicating to which system each alarm is connected.

2.6.2 Fire Alarm

Provide equipment for the automatic transmittal of an alarm over the building fire alarm system. Arrange so that the detection system and the flow of solution in each system will actuate the alarm. .

2.6.2.1 Pressure Switch

Provide switch with SPDT contacts to automatically transmit alarms upon flow of water or foam systems. Alarm actuating device shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle.

2.6.3 Trouble Alarm

Provide local 4 inch electric alarm horn to indicate trouble or failure of the detection system or pre-action sprinkler piping system. Also connect trouble alarm into the building fire alarm control panel to indicate "trouble" on a separate zone labeled "Foam System Trouble".

2.7 FOAM CONCENTRATE

2 percent high expansion foam.

2.8 PROPORTIONING EQUIPMENT

Foam solution shall be produced by introducing foam concentrate into the water stream by mechanical induction proportioning method using a diaphragm pressure tank and ratio controller.

2.8.1 Diaphragm Pressure Proportioning Tanks

Tanks shall be cylindrical steel ASME pressure vessels with a full Buna-N impregnated nylon inner tank or bladder designed to contain AFFF concentrate and to be used in conjunction with the concentrate ratio controller. Tanks shall be designed for working pressure of 175 psig and hydrostatically tested at 1.5 times the working pressure in accordance with ASME standards at the factory. Tanks shall have UL or FM label and ASME stamp affixed to the vessel. Size tank to provide sufficient AFFF concentrate for the time specified when the system is discharging foam solution at total maximum system flow. Also provide connected reserve tanks(s) of equal capacity. Permanently label each tank with its capacity, type and percentage of concentrate, which system(s) it serves, and whether it is a main or reserve tank. Conspicuously post filling instructions near each group of tanks. Provide a gage or unbreakable sight glass to permit visual determination of level of tank contents. Prior to shop painting, abrasive blast clean tank exterior surface in accordance with SSPC SP 6/NACE No.3 to a surface profile not to exceed 2.0 mils and provide a MIL-DTL-24441 or SSPC coating system to the tank exterior. Prime tank exterior with one coat of MIL-DTL-24441/1, Formula 150 or SSPC Paint 22 primer applied to a dry film thickness of 3 mils and topcoat with one coat of MIL-DTL-24441/7 Formula 156 (red) or SSPC Paint 22 topcoat (red) applied to a dry film thickness of 3 mils.

2.8.2 Concentrate Ratio Controller

Ratio controller shall be a modified venturi device with AFFF concentrate feed line from diaphragm tank(s), and integral concentrate metering orifice. Size for specified flow rate(s).

2.9 PRESSURE PROPORTIONING SYSTEM

Foam solution shall be produced by introducing foam concentrate into the water stream by a flanged proportioner. Provide proportioning system and storage tanks for hose lines independent of main proportioning system and tanks.

2.10 High Expansion Foam Generators

The foam generator(s) shall be powered by a water reaction motor. The water reaction motor shall provide both the screen wetting solution and the energy to drive the fan. The foam generator(s) shall not require any outside power source, such as electricity or gasoline engines. All foam generator(s) designed for fixed installation shall be equipped with a stainless steel screen for maximum reliability under fire conditions. The foam generator(s) shall be Underwriters Laboratories (UL) listed and/or Factory Mutual (FM) approved.

2.11 ABOVEGROUND PIPING SYSTEMS

2.11.1 Pipe, Fittings, and Mechanical Couplings

NFPA 13, steel piping shall be Schedule 40 for sizes smaller than 8 inches, and Schedule 30 or 40 for sizes 8 inches and larger. Pipe nipples 6 inches long and shorter shall be Schedule 80 steel pipe. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall only be permitted in pipe sizes 1 1/2 inches and larger. Rubber gaskets shall be UL listed for use in dry-pipe sprinkler systems. Use of restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings (which utilize steel gripping devices to bite into the pipe when pressure is applied) are not permitted. Pipe and fittings in contact with foam concentrate shall be stainless steel. Fittings on concentrate lines shall be flanged or welded only. Screwed or mechanical fittings will not be permitted.

2.11.2 Jointing Material

CID A-A-58092, Polytetrafluoroethylene (PTFE) tape. Pipe joint compound (pipe dope) is not acceptable.

2.11.3 Duplex Basket Strainers

FS WW-S-2739, Style Y (Y pattern). Provide duplex basket strainers with removable screens having standard perforations, 0.125 inch in diameter in the riser upstream of the deluge valves.

2.11.4 Pipe Hangers and Supports

NFPA 13.

2.11.5 Valves

Provide valves as required by NFPA 13 and of types approved for fire service. Gate valves shall open by counterclockwise rotation. Check valves shall be flanged clear opening swing check type with flanged inspection and access cover plate for sizes 4 inches and larger. Provide an OS&Y valve beneath each deluge valve in each riser, when more than one valve is supplied from the same water supply pipe. Butterfly valves are not acceptable.

2.11.6 Identification Signs

Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix design data nameplates to the riser of each system.

2.11.7 Inspector's Test Connection

Provide test connections about 6 feet above the floor for each sprinkler system and locate at the hydraulically most remote part of each system. Provide test connection piping to a location where the discharge will be readily visible and where water may be discharged without damage.

2.11.8 Main Drains

Provide drain piping to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily receive the

full flow from each drain under maximum pressure. Provide auxiliary drains as required by NFPA 13.

2.11.9 Pipe Sleeves

Provide where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 1/4 inch space between exterior of piping and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement.

2.11.9.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A53/A53M, schedule 40 or standard weight, zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above the finished floor.

2.11.9.2 Sleeves in Partitions

Provide zinc-coated steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

2.11.10 Escutcheon Plates

Provide one piece or split hinge type plates for piping passing through floors, walls and ceilings, in both exposed and concealed areas. Provide chromium plated metal plates where pipe passes through finished ceilings. Provide other plates of steel or cast iron with aluminum paint finish. Securely anchor plates in place.

PART 3 EXECUTION

3.1 EXCAVATION, BACKFILLING, AND COMPACTING

Provide under this section as specified in Section 31 00 00 EARTHWORK.

3.2 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the mains; bolt valve conforming to AWWA C500 or UL 262 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required; approval shall be received before any service is interrupted. Furnish all material required to make connections into the existing water supply systems, and perform all excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.3 FOAM SYSTEM INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the NFPA standards referenced herein. Install piping straight and true to bear evenly on hangers and supports. Conceal piping to the maximum extent possible. Piping shall be inspected, tested and approved before being concealed. Provide fittings for changes in direction of piping and for all

connections. Make changes in piping sizes through standard reducing pipe fittings; do not use bushings. Cut pipe accurately and work into place without springing or forcing. Ream pipe ends and free pipe and fittings from burrs. Clean with solvent to remove all varnish and cutting oil prior to assembly. Make screw joints with PTFE tape applied to male thread only.

3.4 DISINFECTION

Disinfect new water piping from the system control valve to the point of connection at the water main and existing water piping affected by the Contractor's operation in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of free available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 ppm.

3.5 FIELD PAINTING

Clean, prime, and paint new foam systems including valves, piping, conduit, hangers, miscellaneous metal work, and accessories. Apply coatings to clean dry surfaces using clean brushes. Clean the surfaces in accordance with SSPC SP 3 . Immediately after cleaning, prime the metal surfaces with one coat of SSPC Paint 25 or SSPC Paint 25 primer applied to a minimum dry film thickness of 1.5 mils. Exercise care to avoid the painting of sprinkler heads and operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices while painting is in process. Remove sprinkler heads and operating devices which have been inadvertently painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:

3.5.1 Foam Systems in Unfinished Areas

Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, foam rooms, pump rooms, pipe chases, and other spaces where ceilings are not painted or not constructed of a prefinished material. Paint primed surfaces with one coat of CID A-A-2962 red enamel applied to a minimum dry film thickness of 1.5 mils.

3.5.2 Foam Systems in All Other Areas

Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with one coat of CID A-A-2962 red enamel applied to a minimum dry film thickness of 1.5 mils. Provide piping with 2 inch wide red bands spaced at maximum 20 foot intervals throughout the piping systems. Bands shall be red enamel or self adhering red plastic tape.

3.5.3 Piping Labels

Provide permanent labels in foam rooms, spaced at 20 foot maximum intervals along pipe, indicating "WATER", "FOAM CONCENTRATE", and "FOAM SOLUTION" on corresponding piping.

3.5.4 Field Touch-Up

Clean damaged areas of shop coated tanks in accordance with SSPC SP 11 and coat cleaned areas with the same materials used for the shop applied

coating system.

3.6 ELECTRICAL WORK

Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Fire alarm system is specified in Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

3.6.1 Wiring

Provide control wiring, and connections to fire alarm systems, under this section in accordance with NFPA 70 and NFPA 72. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage. Do not run low voltage DC circuits in the same conduit with AC circuits.

3.7 FLUSHING

Flush the piping system with potable water in accordance with NFPA 13. Continue flushing operation until water is clear, but for not less than 10 minutes.

3.8 FIELD QUALITY CONTROL

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals. Perform tests in the presence of the Contracting Officer to determine conformance with the specified requirements.

3.8.1 Foam Generators

Foam generators shall be discharged tested for proper operation and coverage. The design flow of the overhead water system shall be simulated during generator discharge testing. Pressure readings shall be taken at each generator during testing to verify hydraulic calculations. See detailed requirements below.

3.8.2 FOAM CONCENTRATE SYSTEM

Tests shall be conducted under the supervision of a technical representative employed by the foam concentrate manufactures. The complete foam concentrate system shall be adjusted and tested to assure proper operation. Test results, including pressure settings and readings, shall be recorded on an appropriate test form signed and dated by manufacuter's representative certifying that the system is in compliance with contract requirements and the manufacturer's recommended practices. Testing shall include, but not be limited to, the followings:

a. Filling the foam concentrate tank.
b. Adjustment of proportioners.
d. Collection of foam samples and testing with a conductivity meter to verify proportioning accuracy.
e. Reading of high expansion foam in tanks before and after testing shall be taken, along with test time, to determine adequacy of tank for 15 minute supply.

3.8.3 Formal Inspection and Tests (Acceptance Tests)

The Contracting Officer will witness formal tests and approve all systems before they are accepted. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and written certification to this effect is received by the Contracting Officer. Submit the request for formal inspection at least 15 working days prior to the date the inspection is to take place. The control panel(s) and detection system(s) shall be in continuous service for a "break-in" period of at least 15 consecutive days prior to the formal inspection. Experienced technicians regularly employed by the Contractor in the installation of both the mechanical and electrical portions of such systems shall be present during the inspection and shall conduct the testing. All foam concentrate, instruments, personnel, appliances and equipment for testing shall be furnished by the Contractor. All necessary tests encompassing all aspects of system operation shall be made including the following, and any deficiency found shall be corrected and the system retested at no cost to the Government.

3.8.4 Systems and Device Testing

The entire initiating, alarm, and actuation systems shall be operated. At a minimum, operation and supervision of the following functions and devices shall be demonstrated:

a. All operational and supervisory functions of the control and annunciator panels.

b. Each manual actuation station, abort switch and associated circuit(s).

c. All detectors and associated circuits.

d. All alarms and associated circuits.

e. All actuator circuits and system control valve(s) (without foam discharge).

f. Activation of the building fire evacuation alarm system.

g. Activation of the Base fire alarm system (receipt of fire alarm at alarm office).

h. All of the above tests shall then be repeated with the system on battery power only.

3.8.5 FoamDischarge and Concentration Testing

When all of the initiating, alarm, actuation, and supervisory functions of the system operate to the satisfaction of the system manufacturer's technical representative and the Contracting Officer, a complete discharge test of each system shall be performed to demonstrate satisfactory performance, proper foam concentration, mechanical operation and operation of valves, release devices, alarms, and interlocks which control the protected areas. These tests shall be conducted by experienced personnel according to the equipment and foam manufacturers' recommendations.

a. Test each deluge system by full flow of foam solution to achieve minimum foam coverage in 1 minute and foam depth within 4 minutes.

The manufacturer's representative shall test samples of foam solution taken from each system to ensure proper foam concentration. Provide protection for all electrical fixtures and equipment exposed to possible damage during tests and protect doors and other openings leading from the protected area(s), to prevent migration of foam solution into other areas or spaces.

3.8.6 Preliminary Tests

Each piping system shall be hydrostatically tested at 200 psig in accordance with NFPA 13 and shall show no leakage or reduction in gage pressure after 2 hours. The Contractor shall conduct complete preliminary tests, which shall encompass all aspects of system operation. Individually test all detectors, manual actuation stations, alarms, control panels, and all other components and accessories to demonstrate proper functioning. Test water flow alarms by flowing water through the inspector's test connection. When tests have been completed and all necessary corrections made, submit to the Contracting Officer a signed and dated certificate, similar to that specified in NFPA 13, attesting to the satisfactory completion of all testing and stating that the system is in operating condition. Also include a written request for a formal inspection and test.

3.8.7 High Expansion Foam Test Plan And Preliminary Acceptance Test

Provide an intiital test plan with test procedures 60 days prior to final acceptance test. Include the following information:

a. Schedule of tests for each day, Example: Day 1, Day 2, Day 3 etc.
b. List of tests.
c. Blank Forms for recording test data for each test.
d. Test procedure for each test.
e. List of equipment required for each test.
f. Calibration certificates for testing equipment.

3.8.8 Preliminary Acceptance Test

Perform preliminary acceptance test for the entire fire protection system. Provide written confirmation of all preliminary test results. A professional videographer shall record digitally or on videotape all preliminary tests to document the methods and equipment employed to conduct the test. This digital recording shall be provided by the Contractor. The preliminary test shall include stray voltage test and loop resistance tests. Perform 100% of system testing including foam discharge.

3.8.9 High Expansion Foam Tests

The high expansion foam hangar fire suppression system flow tests shall include the following:

a. Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing water only. Take pressure readings at each foam generator and risers with calibrated liquid filled gages.
b. Simultaneous flow of simulated overhead sprinkler system maximum demand and foam generators flowing foam for one minute. Verify ETL 02-15 coverage criteria of 90% of the aircraft silhouette be covered in one minute (no depth is specified) and that the entire hangar floor be covered to a depth of one meter in 4 minutes. Foam discharge will continue until these criteria are deemed to be satififed. Take foam tank level readings at beginnning and at end. Overhead sprinkler system maximum demand shall be simulated by using a simulation test

header, UL listed play pipes and liquid filled pressure gages.
c. Foam tank level readings shall be recorded at the beginnning and at the end.

3.8.10 Safety Plan

Provide a safety plan for conducting the test of the High Expansion Foam system. Provide a sketch of safe egress path for persons conducting and witnessing the test to exit the building without entering the foam blanket. Obtain approval from the installation Safety Manager.

3.8.11 Disposal Plan And Protection

a. Provide Foam Containment Plan and Procedures
b. Provide Foam Disposal Plan and Procedures
c. Provide Protective Measures: Provide procedures for taking protective measures to avoid damage to property during and after the test and protection of property during the Final Acceptance Test. Provide a 10 mil plastic barrier for protection of equipment and property as required over entire area.

3.8.12 Preliminary Acceptance Test Report

Submit the preliminary acceptance test reort to the Contracting Officer before requesting a Final Acceptance Test. Provide the preliminary acceptance test report, digital recording or videotape of the preliminary test, a "Punch List" (list of deficiencies prepared at the completion of preliminary test), and a Final Acceptance Test plan 15 days prior to final acceptance test.

3.8.13 Final Acceptance Test Report

Provide the Final Acceptance Test Report within 15 days after the completion of the Final Acceptance Test. Provide the final acceptance test report in booklet form showing field tests performed with the digital or videotape of the final test to document compliance with the specified performance criteria. Provide documentation of readings, test results, and indicate the final position of control valves. Include all required Final Acceptance Test NFPA forms. The Final Acceptance Test report shall inclue the resolution of punch list items developed during preliminary acceptance testing.

3.8.14 Posted Instructions

Framed description of system operation, instructions and schematic diagrams of the overall foam system and each subsystem, shall be posted where directed. Condensed operating instructions explaining the system for normal operation, refilling the foam storage tank, and routine testing shall be included.

3.8.15 Training

The Contractor and manufacturer's representatives shall conduct four 6-hour training courses per building; two for operators and two for maintenance personnel designated by the Contracting Officer. Lesson plans, operating instructions, maintenance procedures, and training data shall be furnished in manual format for the training courses. The operations training course shall familiarize designated government personnel with proper operation of the fire protection systems. The maintenance training

course shall provide designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. The training sessions shall be given for two different work shifts. The schedule of training shall be approved by the Contracting Officer. Training sessions shall start after successful completion of the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved O&M manual. Film or tape all training sessions and provide to the Contracting Officer.

3.8.16 Flushing and Rinsing

After completion of tests flush all piping carrying foam concentrate and solution with fresh water. Piping normally containing foam concentrate when the system is in standby mode need not be flushed. Rinse with fresh water all equipment and building surfaces exposed to foam discharge.

3.8.17 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

3.8.18 FoamConcentrate Storage Tanks

Fill storage tanks including reserve tanks and piping normally containing concentrate when the system is in standby mode with Contractor furnished 2% high expansion foam concentrate after acceptance of the system.

3.8.19 Manufacturer's Representative

Provide the services of representatives or technicians from the manufacturers of the foam system, and control panel , experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

3.9 OPERATING INSTRUCTIONS

Provide operating instructions at control equipment and at each remote control station. Instructions shall clearly indicate all necessary steps for the operation of the system. Submit the proposed legend for operating instructions for approval prior to installation. Instructions shall be in engraved white letters on red rigid plastic or red enameled steel backgrounds and shall be of adequate size to permit them to be easily read.

3.10 TRAINING REQUIREMENTS

Prior to final acceptance, the Contractor shall provide two sessions of 4 hours each of operation and maintenance training to the Base Fire Department and NASA Facilities personnel on two different days to accommodate both shifts of the Base Fire Department. Each training session shall include emergency procedures, and unique maintenance and safety requirements. Training areas will be provided by the Government in the same building as the protected areas. The training conducted shall use

operation and maintenance manuals specified in paragraph entitled "Operations and Maintenance Manuals". Dates and times of the training period shall be coordinated through the Contracting Officer not less than two weeks prior to the session.

-- End of Section --

SECTION 21 13 24.00 10

AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM
10/07

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.

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems
ASME B16.1	(2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASTM INTERNATIONAL (ASTM)

ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A312/A312M	(2012) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A351/A351M	(2012a) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A403/A403M	(2012) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A449	(2010) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe,

	Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM F436	(2011) Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 11	(2010; TIA 10-1) Standard for Low-, Medium- and High- Expansion Foam
NFPA 13	(2013) Standard for the Installation of Sprinkler Systems
NFPA 16	(2011) Standard for Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-F-24385	(1992; Rev F; Am 1 1994) Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater
UFC 3-310-04	(2012) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Provide an AFFF System consisting of an automatic wet-pipe foam-water fire protection system used for the hand hose stations as indicated on the drawings. Submit a copy of the proposed diagrams and instructions for the overall AFFF system, prior to posting. Except as modified herein, the system shall meet the requirements of NFPA 11, NFPA 13, NFPA 16 and NFPA 72.

b. The wet-pipe system shall operate by manual activation which will cause water to flow through the the hand hose station and foam-water solution to be discharged from the nozzle system.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-built Drawings

SD-03 Product Data

Materials and Equipment; G
Spare Parts
AFFF System; G
Installer's Qualifications; G
Post-discharge Test Requirements; G

SD-06 Test Reports

Test Reports; G

SD-07 Certificates

Materials and Equipment; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

1.4 QUALITY ASSURANCE

The advisory provisions of NFPA standards and recommended practices specified shall be considered mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In the event of a

conflict between referenced NFPA standards and this specification, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

1.4.1 Submittal Preparer's Qualifications

The fire protection system submittals, including as-built drawings, shall be prepared by an individual who is either a registered professional engineer with ten years experience designing AFFF systems or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. Submit one set of reproducibles and six copies, within 14 calendar days after successful completion of required testing. A separate set of approved submittal drawings of the overall system, marked up to indicate as-built conditions, shall be maintained onsite in a current condition at all times and shall be made available for review immediately upon request during normal working hours. Variations from the approved drawings, for whatever reason, including those occasioned by modifications, change orders, optional materials, and/or required for coordination between trades shall be indicated in sufficient detail to accurately reflect the as-built conditions.

1.4.2 Installer's Qualifications

Provide a statement attesting that the proposed installer is regularly engaged in the installation of the type and complexity of system included in this project. Submit, in addition, data identifying the locations of at least three systems recently installed by the proposed installer which are comparable to the system specified. Certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months.

1.4.3 Detail Drawings

Submit detail drawings conforming to the requirements prescribed in NFPA 13; drawings shall be 30 x 42 inches. Drawings shall include plan and elevation views which establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. A descriptive index with drawings listed in sequence by number. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

b. Floor plans drawn to a scale not less than 1/8 inch equals 1 foot clearly showing locations of devices, equipment, risers, electrical power connections, areas covered by each nozzle, and other details required to clearly describe the proposed arrangement.

c. Piping plan for each hand hose system. Nozzles and associated piping shall be shown. Abbreviated presentation forms will not be accepted. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be identified.

d. Piping plan and isometric drawing of the AFFF concentrate system and details of all associated valves, fittings, and other components. Drawing shall indicate all operational features including, but not limited to, relief valve open/close, pressure sustaining valve

open/close.

e. Location of control panels, detectors, manual stations, supervisory switches, solenoids, notification appliances, and other electrical devices. In addition, conduit routing and sizes, and the number of conductors contained in each shall be indicated.

f. Equipment room layout drawings drawn to a scale of not less than 1/2 inch equals 1 foot to show details of each system component, clearances between each other and from other equipment and construction in the room.

g. Details of each type of pipe hanger, sway bracing for earthquake protection, proportioners, nozzles and mounting details, AFFF system control valve header and related components.

h. Connection drawings and control diagrams indicating overall electrical and mechanical operation of the AFFF system. This shall include identification and operation of each major component of the system. Diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate foam system control panel wiring and make and model of devices and equipment connected thereto.

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit manufacturer's catalog data for each separate piece of equipment proposed for use in the system. Data shall indicate the name of the manufacturer of each item of equipment, with data highlighted to indicate model, size, options, etc. proposed for installation. In addition, provide a complete equipment list with equipment description, model number, and quantity and certificates from manufacturers to substantiate that components, equipment and material proposed for installation and use meet requirements as specified. Certificates shall be on a form for this purpose or on official letterhead of the manufacturer with specified information stated as required. Certificate shall be signed by an officer of the corporation. Submit certificates for the following:

a. AFFF concentrate. Certification that AFFF concentrate proposed for use has been tested and is in compliance with MIL-F-24385.

b. AFFF concentrate control valve. Certification that the valve is designed and, constructed as specified and will function as intended.

c. AFFF proportioning system. Certification that the foam proportioning system complies with contract specifications and manufacturer's recommendations.

2.2 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate permanently affixed to the item of equipment.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

All equipment and material shall have been tested by Underwriters Laboratories, and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

2.4 PRESSURE RATINGS

Valves, fittings, couplings, proportioners, alarm switches, strainers, and similar devices shall be rated for the maximum working pressures that can be experienced in the system, but in no case less than 175 psi.

2.5 ABOVEGROUND PIPING SYSTEMS FOR WATER OR AFFF SOLUTION

2.5.1 Pipe

Pipe shall be standard weight conforming to ASTM A53/A53M. Pipe 6 inch diameter and smaller shall be Schedule 40. Pipe shall be marked as to the brand or name of the manufacturer, kind of pipe and the ASTM designation in accordance with the "Product Marking" provisions of the ASTM standard.

2.5.2 Grooved Fittings and Couplings

Grooved fittings, couplings and bolts shall be provided by the same manufacturer. Fittings and couplings shall be malleable iron complying with ASTM A47/A47M or ductile iron complying with ASTM A536. Couplings shall be of the rigid type except that flexible type will be provided where flexible joints are specifically required by NFPA 13. Coupling gaskets shall be Grade E (EPDM) approved for dry pipe fire protection service. Gasket shall be the flush type that fills the entire cavity between the coupling and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.5.3 Non-Grooved Fittings

Non-grooved fittings shall be threaded or flanged. Threaded fittings shall be cast iron conforming to ASME B16.4 or malleable iron conforming to ASME B16.3. Flanged fittings shall be cast iron conforming to ASME B16.1. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are

screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings which require drilling a hole in the pipe, and fittings which use steel gripping devices to bite into the pipe, shall not be used.

2.5.4 Flanges and Gaskets

Flanges shall conform to NFPA 13 and ASME B16.1. Flanges shall be the type that are welded or threaded to the pipe. Flanges which are bolted to grooved pipe will not be permitted. Gaskets shall be full face type EPDM or other approved material.

2.5.4.1 Bolts

Bolts shall be ASTM A449, Type 1 . Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.4.2 Nuts

Nuts shall be ASTM A193/A193M, Grade 5 .

2.5.4.3 Washers

Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and be of the type suitable for the application, construction and size pipe involved.

2.5.6 Control Valve

Unless otherwise indicated, valves shall be indicating type in accordance with NFPA 13. Valves 2-1/2 inch and larger shall be flanged outside screw and yoke (OS&Y) type.

2.5.7 Check Valve

Check valves 4 inches and larger shall be flanged, swing type, cast or ductile iron body and cover, cast or ductile iron clapper with replaceable EPDM rubber facing. Valves shall be suitable for either vertical or horizontal mounting and equipped with a removable handhole cover. The direction of flow shall be indicated by an arrow cast in the valve body. The valve body shall include plugged pipe thread connections for a 2 inch drain.

2.6 ABOVEGROUND PIPING SYSTEMS FOR AFFF CONCENTRATE

2.6.1 Pipe

Pipe shall be standard weight stainless steel conforming to ASTM A312/A312M, Grade TP 304L.

2.6.2 Fittings

Seamless socket weld type or flanged type fittings shall conform to ASTM A403/A403M, Grade WP 304L, and shall be compatible with the pipe. Grooved type fittings and couplings shall be of Type 316 Stainless Steel conforming to ASTM A351/A351M.

2.6.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and be of the type suitable for the application, construction and size pipe involved.

2.6.4 Control Valves

Valve shall be indicating type with full port ball and operating handle that indicates the on/off position of the valve. Unit shall be socket weld or flanged type. Valve body and ball shall be of 316 stainless steel complying with ASTM A351/A351M. The valve handle shall be provided with a suitable and substantial means for securing the valve open with a key-operated locking device.

2.7 DISCHARGE DEVICES

2.7.1 Fixed Nozzle

Nozzle shall be of fixed constant flow type, cast brass construction 1-1/2 inch male NPT, suitable for use with AFFF solution. Nozzle shall be factory set for required discharge characteristic. Discharge characteristic or k-factor(s) shall be as indicated on the drawings. Nozzle discharge pattern shall be field adjustable and lockable. Nozzle flow and effective reach of discharge at various nozzle patterns shall have been determined by the manufacturer's actual discharge tests with nozzles in horizontal pattern at nozzle flow of 60 gpm. Nozzle settings shall be factory set. Field disassembly, adjustment or assembly which could alter discharge characteristic will not be permitted.

2.8 AFFF LIQUID CONCENTRATE

AFFF concentrate shall be 3 percent conforming to MIL-F-24385. Concentrate shall be the product of one manufacturer. Mixing of non-identical brands of concentrate will not be permitted.

2.9 PROPORTIONING SYSTEM

2.9.1 AFFF Concentrate Storage Tank

Tank shall be designed for storage of AFFF concentrate at atmospheric pressure and shall be horizontal cylindrical, high density steel construction. Individual tank capacity shall be a minimum of 36 gallons. Tank shall be translucent and equipped with level gauge strip for approximating quantity of tank contents. Tank shall be equipped with the following: inspection hatch; valved drain/fill connection; foam concentrate pump suction and return connections (with flex connectors); pressure/vacuum vent; low liquid level float switch; seismic tie downs and other accessories required for proper operation shall be in accordance with UFC 3-310-04. Openings and tank connections shall be installed at the factory, no holes shall be made in the tank shell in the field. Tank shall include necessary supports for free standing installation.

2.10 BALANCED PRESSURE PROPORTIONER (RATIO CONTROLLER)

The proportioner shall be an in-line balanced pressure type unit capable of proportioning AFFF liquid at 3 percent, (3 parts concentrate to 97 parts water by volume solution) at flow rates within the flow range of the proportioner. Major components of the proportioner, including the body,

inlet nozzle and metering orifice shall be of brass, bronze or stainless steel. The body shall be clearly marked with a flow-direction arrow, and the type and percent of AFFF concentrate that it was designed to proportion. The proportioner size shall be 2 inch . The in-line balanced pressure proportioner shall be an assembly that includes a proportioner as described, integral pressure balancing valve with duplex pressure gauge, inlet pressure gauge and manual ball valve. The proportioner assembly shall be factory assembled and tested as an assembly by one manufacturer. Field disassembly or assembly of any component part will not be accepted. Components shall be of the make/model required by the specific UL listing or FM approval.

2.11 AFFF CONCENTRATE CONTROL VALVE ASSEMBLY

Assembly shall be specifically designed and constructed to control AFFF concentrate to proportioners and shall be arranged to open upon application of water. All components shall be constructed of brass, bronze or stainless steel, except that the internal portions of listed or approved fire protection valves subjected to AFFF concentrate may be provided with a coating warranted by the manufacturer to protect the valve from the deleterious effects of the concentrate. All components shall be rated for working pressure of 175 psi or maximum working pressure to which they could be subjected, whichever is greater. Valve shall be certified by the manufacturer to be operable with water inlet pressure as low as 30 psi. Valve components shall be brass, bronze or stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Aboveground Piping

Piping shall be installed straight and bear evenly on hangers and supports. Preaction sprinkler system piping shall be pitched as if it were being installed in areas subject to freezing. Piping shall be concealed in areas with suspended ceiling and shall be inspected, tested and approved before being concealed.

3.1.1.1 Joints

Pipe joints shall conform to NFPA 13. Not more than four threads shall show after joint is made up. Joint compound shall be applied to male threads only. Joints shall be faced true, provided with gaskets and made square and tight. Flanged joints or mechanical groove couplings shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published installation instructions. All grooved couplings and fittings shall be from the same manufacturer. 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.

3.1.1.2 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in

elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

3.1.1.3 Pipe Supports and Hangers

Installation methods outlined in NFPA 13 are mandatory. Protection of piping against damage from earthquakes shall be provided. Longitudinal and lateral sway bracing shall be provided for piping 2-1/2 inch diameter and larger.

3.1.1.4 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes penetrating concrete or masonry walls or concrete floors shall be provided with pipe sleeves fitted into place at the time of construction through its respective wall or floor, and shall be cut flush with each surface. Sleeve sizes and clearance between pipe and sleeve shall be in accordance with NFPA 13. Where pipes pass through fire walls, fire partitions, or floors, a fire seal shall be placed between the pipe and sleeve in accordance with Section 07 84 00 FIRESTOPPING.

3.1.1.5 Piping Pitch

Piping shall be pitched to the main drain or to auxiliary drains provided as required to facilitate draining. Branch lines shall be pitched at least 1/2 inch in 10 feet and crossmains and feedmains shall be pitched to at least 1/4 inch in 10 feet.

3.1.1.6 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe and shall be chromium-plated iron or chromium-plated brass, either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.1.1.7 Drains

Main drain piping shall be provided to discharge at safe points outside each building. Drains shall be of adequate size to readily receive the full flow from each drain under maximum pressure. Auxiliary drains shall be provided as required by NFPA 13 except that drain valves shall be used where drain plugs are otherwise permitted. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line. Each drain valve shall be provided with a metal sign identifying the type of drain connection or function of the valve.

3.1.1.8 Identification Signs

Signs shall be in accordance with NFPA 13. Properly lettered and approved metal signs shall be suitably affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate.

3.2 ELECTRICAL WORK

Unless otherwise specified, power supply equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2.1 Overcurrent and Surge Protection

Equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1, IEEE C62.41.2 and NFPA 70. Cables and conductors which serve as communication links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.2.2 Grounding

Grounding shall be provided to building ground.

3.2.3 Wiring

System field wiring shall be installed in 3/4 inch minimum diameter electrical metallic tubing or metallic conduit. Wiring for the sprinkler system fire detection and control system shall be installed in tubing or conduits dedicated for that use only and shall not be installed in conduit, outlet boxes or junction boxes which contain lighting and power wiring or equipment. Circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked and labeled in accordance with the wiring diagram. No more than one conductor shall be installed under any screw terminal. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors is not permitted. Wiring within any control equipment shall be readily accessible without removing any component parts. Conductors shall be color coded and shall be identified within each enclosure where a connection or termination is made. Conductor identification shall be by plastic coated, self-sticking, printed markers, or by heat-shrink type sleeves. Circuits shall be wired to maintain electrical supervision so that removal of any single wire from any device shall cause a "trouble" condition on the control panel.

3.3 PIPE PAINTING AND LABELING

3.3.1 Painting

Black steel pipe shall be painted to match existing and AFRC requirements. Pipe in equipment rooms shall be painted red. Pipe in other areas shall be painted to match finishes in those areas. Stainless steel pipe shall not be painted.

3.3.2 Pipe Identification

Aboveground pipe 2 inch diameter and larger shall be identified with legends. Legends shall include FOAM CONCENTRATE, FOAM-WATER NOZZLE, and FIRE PROTECTION WATER. Legends shall utilize WHITE letters on a RED color field and shall include arrows to indicate the direction of flow. Length of color field, letter size and locations on piping shall be as recommended in ASME A13.1.

3.4 PRELIMINARY TESTS

Tests shall be performed to make adjustments in the fire protection system operation and to verify that the system will function as intended and that it is ready for service. Such tests shall include all components and subsystems. Test results shall be clearly documented and included with the written request for Final Test.

3.4.1 Hydrostatic Tests

The underground and aboveground piping systems, including AFFF concentrate, shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi, or 50 psi in excess of maximum system operating pressure, for 2 hours. There shall be no visible leakage from the piping when the system is subjected to the hydrostatic test.

3.4.2 Nozzles

Nozzles shall be discharge tested for proper operation and coverage. Oscillating nozzles shall be operated to verify that angle of elevation, angle of oscillation, and discharge range, are in accordance with requirements.

3.4.3 AFFF Concentrate System

Tests shall be conducted under the supervision of a technical representative employed by the AFFF concentrate manufacturer. The complete AFFF concentrate system shall be adjusted and tested to assure proper operation. Test results, including all pressure settings and readings, shall be recorded on an appropriate test form signed and dated by manufacturer's representative certifying that the system is in compliance with contract requirements and the manufacturer's recommended practices. Testing shall include, but not be limited to, the following:

a. Filling the AFFF concentrate tank.

b. Adjustment of pressure sustaining valves, and proportioners.

c. Collection of AFFF samples and testing with a conductivity meter to verify proportioning accuracy.

d. Other operational checks recommended by the AFFF proportioner manufacturer.

3.5 FINAL TEST

3.5.1 Requirements

The Final Test shall be a repeat of Preliminary Tests, except that flushing and hydrostatic tests shall not be repeated. In addition, the system shall be automatically actuated and allowed to discharge for a period of at least one minute prior to shutting the system off. Correct system failures and other deficiencies identified during testing and shall retest portions of the system affected by the required corrections.

3.5.1.1 Pretest Requirements

The system will be considered ready for final testing only after the following have been accomplished.

a. The required test plan has been submitted and approved.

b. Preliminary tests have been made and deficiencies determined to have been corrected to the satisfaction of the equipment manufacturer's

technical representatives and the Contracting Officer.

c. Test reports, including the required videotape of the preliminary tests, have been submitted and approved.

d. The Contractor has provided written notification to the Contracting Officer, at least 21 days prior to date of Final Test, that preliminary tests have been successfully completed.

3.5.1.2 Videotaping

Videotape the tests in VHS format and record the date and time-lapse, in seconds, from start to finish of each portion of the test as directed by the Contracting Officer. Submit four copies of the tape before the system will be considered accepted.

3.5.1.3 Manufacturer's Services

Experienced technicians regularly employed by the Contractor in the installation of the system and manufacturer's representative referred to elsewhere in this specification shall conduct the testing.

3.5.1.4 Materials and Equipment

Provide AFFF concentrate, gauges, AFFF sample collection apparatus, instruments, hose, personnel, elevating platforms, scaffolding, ladders, appliances and any other equipment necessary to fulfill testing requirements specified.

3.5.1.5 Facility and Environmental Protection

Provide protection for the facility, including electrical and mechanical equipment exposed to possible damage during discharge tests. This shall include provision of sandbags or similar means for preventing migration of foam solution into adjacent areas. Temporary measures shall be provided to prevent AFFF solution from entering storm drains, sanitary sewers, drainage ditches, streams and other water sources. Discharged AFFF shall be contained on paved surfaces and shall not be allowed to come in contact with the earth.

3.5.2 AFFF Proportioning System Tests

Each AFFF proportioner shall be flow tested to determine that proportioning accuracy is within specified limits. Each proportioner supplying a nozzle system shall be tested at the design flow rate. Collecting AFFF samples from each proportioner shall be accomplished in accordance with NFPA 16, and the approved test plan. Foam solution concentrations shall be determined using the methods outlined in NFPA 16. Proportioning for nominal 3 percent concentrate shall be between 3 percent and 4 percent. If test results indicate proportioning below or above this range, make necessary adjustments and retest as directed by the Contracting Officer.

3.5.3 Post-discharge Test Requirements

Following the successful completion of the tests, remove the foam solution from the site. Replenish AFFF concentrate consumed during the tests. The entire fire protection system shall be returned to automatic operation and the facility restored to operational capability. Discharged solution shall be contained and disposed of in a manner acceptable to local authorities

and as identified on the approved test plan. Once tests are completed, systems shall be returned to fully operational status, including filling of AFFF concentrate tanks with concentrate and filling of solution piping with premix as required. Submit details of method proposed for required tests at Final Acceptance, including step-by-step test procedures; list of equipment to be used; names, titles, and affiliations and qualifications of personnel who will participate in the tests; methods for protecting the facility and equipment during testing; means for containing the AFFF solution during discharge tests; and proposed means for disposal. Test plan shall include a drawing showing proposed number and arrangement of fire hoses and nozzles proposed for use in testing foam proportioners. Include blank forms to be used for recording test results. Submit test reports and videotapes as specified herein:

a. Reports as outlined in NFPA 13 documenting results of flushing and hydrostatic tests.

b. Trip tests of alarm check valves.

c. Test report of AFFF concentrate proportioning system. Report shall include all pressure readings, pressure sustaining valves, relief valves and similar system components. Report shall include conductivity readings for foam samples taken from each AFFF proportioner. Report shall be signed by the factory-trained technical representative employed by the AFFF concentrate manufacturer.

d. Videotapes of tests specified to be recorded.

3.6 POSTED INSTRUCTIONS

Framed description of system operation, instructions and schematic diagrams of the overall AFFF system and each subsystem, shall be posted where directed. Condensed operating instructions explaining the system for normal operation, refilling the AFFF storage tank, and routine testing shall be included.

3.7 TRAINING

Provide at least two training sessions of at least 6 hours each to explain system's operation and maintenance. Training sessions shall be conducted on alternate days to afford flexibility by shift personnel and other attendees. Training aids shall be provided as necessary to clearly describe the systems. Training sessions shall include classroom instruction and explanation of approved Operation and Maintenance Manuals. Submit 6 manuals in loose-leaf binder format and grouped by technical sections consisting of manufacturer's brochures, schematics, printed instructions, general operating procedures, and safety precautions. Manuals shall include a narrative description of the sequence or sequences of operation of the overall fire protection system and a separate description for each major subsystem. Information to be provided shall include specific start/stop settings for pumps, open/close settings for all adjustable valves (including pressure sustaining and relief valves). The manuals shall list routine maintenance procedures, possible breakdowns, and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout, simplified wiring and control diagrams for the system as installed, procedures and instructions pertaining to frequency of preventive maintenance, inspection, adjustment, lubrication and cleaning

necessary to minimize corrective maintenance and repair. In addition to classroom instruction, systems shall be operated to provide hands-on demonstrations. Include a system actuation using water only, to demonstrate system operation and procedures for resetting the system. Training areas will be provided by the Government in the building where the systems are installed. Dates and times of the training sessions shall be coordinated with the Contracting Officer not less than 15 calendar days prior to the first session.

-- End of Section --

SECTION 21 30 00

FIRE PUMPS
04/08

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 WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B301	(2010) Liquid Chlorine
AWWA C111/A21.11	(2012) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C606	(2011) Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2011) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASTM INTERNATIONAL (ASTM)

ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and

	Other Special Purpose Applications
ASTM A194/A194M	(2012) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A795/A795M	(2008) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B135	(2010) Standard Specification for Seamless Brass Tube
ASTM B42	(2010) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2011) Standard Specification for Seamless Copper Tube
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications
ASTM D3308	(2012) PTFE Resin Skived Tape
ASTM F436	(2011) Hardened Steel Washers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(2013) Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(2003) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

UNDERWRITERS LABORATORIES (UL)

UL 1247	(2007; Reprint Jun 2011) Diesel Engines for Driving Stationary Fire Pumps
UL 448	(2007; Reprint Jan 2011) Centrifugal Stationary Pumps for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

a. Except as modified in this Section or on the drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the Contracting Officer or the AFRC appointed AHJ.

b. Submit 3 copies of the Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

1. Fire pumps, controllers, piping, valves, and associated equipment.

2. Sensing line for each pump including the pressure maintenance pump.

6. Restraint of underground water main at entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

7. A one-line schematic diagram indicating layout and sizes of

all piping, devices, valves and fittings.

8. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

c. Supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

d. Show detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

(1) Pumps, drivers, and controllers

(2) Hose valve manifold test header

(3) Circuit diagrams for pumps

(4) Wiring diagrams of each controller

e. Post operating instructions for pumps, drivers, controllers, and flow meters.

f. Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

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.

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G
As-Built Drawings; G
Piping Layout; G
Pump Room; G

SD-03 Product Data

Fire Pump Installation Related Submittals
Catalog Data; G
Spare Parts
Preliminary Tests
Field Tests; G
Fire Protection Specialist; G
Manufacturer's Representative; G
Field Training; G

SD-06 Test Reports

Preliminary Tests Report
Final Acceptance Test

SD-07 Certificates

Fire Protection Specialist; G
Qualifications of Welders
Qualifications of Installer
Preliminary Test Certification

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions
Flow Meter

1.4 QUALITY ASSURANCE

1.4.1 Fire Protection Specialist

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Concurrent with the Final Acceptance Test Report, submit certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

1.4.2 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.4.3 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.4.4 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.4.5 Manufacturer's Representative

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

1.6 SEQUENCING

1.6.1 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 146 psi , or manually when the starter is operated. Pumps shall continue to run until shut down manually.

1.6.2 Secondary Fire Pumps

Secondary fire pumps shall operate atthe same pressures as the primary fire pump starting pressure. The fire pump shall automatically start once the primary fire pump operates and continue to run until shut down manually. Fire pumps shall be prevented from starting simultaneously and shall start sequentially at intervals of 10 seconds.

1.6.3 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 156 psi. Pump shall automatically stop when the system pressure reaches 166 psi and after the pump has operated for the minimum pump run time specified herein.

1.7 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Materials and equipment shall be 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.

b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

1. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

2. Pressure maintenance pump and controller.

3. Piping components.

4. Valves, including gate, check, globe and relief valves.

5. Gauges.

6. Hose valve manifold test header and hose valves.

7. Flow meter.

8. Restrictive orifice union.

9. Associated devices and equipment.

c. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, contract number and accepted date; capacity or size; system in which installed and system which it controls and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

2.2 FIRE PUMP

Fire pump shall be electric motor driven . Each pump capacity shall be rated at 4000 gpm with a rated net pressure of 145 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall be automatic start and automatic stop. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72. Provide remote alarm devices located at where shown. Alarm signal shall be activated upon the following conditions: electric motor controller has operated into a pump running condition, loss of electrical power to electric motor starter, and phase reversal on line side of motor starter . Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 ABOVEGROUND PIPING COMPONENTS

2.4.1 Pipe Sizes 2.5 inches and Larger

2.4.1.1 Pipe

Piping shall be ASTM A795/A795M, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inchesand greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside in accordance with NFPA 20.

2.4.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.4.1.3 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

2.4.1.4 Gaskets

Gaskets shall be AWWA C111/A21.11, cloth inserted red rubber gaskets.

2.4.1.5 Bolts

Bolts shall be ASTM A193/A193M, Grade B7. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.4.1.6 Nuts

Nuts shall be ASTM A194/A194M, Grade 7.

2.4.1.7 Washers

Washers shall meet the requirements of ASTM F436. Flat circular washers shall be provided under all bolt heads and nuts.

2.4.2 Piping Sizes 2 inches and Smaller

2.4.2.1 Steel Pipe

Steel piping shall be ASTM A795/A795M, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.3, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

2.4.2.2 Copper Tubing

Copper tubing shall be ASTM B88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B42 copper pipe with threaded end connections.

2.4.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

2.4.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service. Valves shall have flange or threaded end connections.

2.4.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

2.4.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.4.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

2.4.5 Pipe Sleeves

A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space 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. In fire walls and fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 0.90 psf.

2.4.6 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

2.5 DISINFECTING MATERIALS

2.5.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.5.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.6 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects shall be provided with their respective pieces of equipment, as specified herein and shall have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors shall have a maximum of

120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section. Motor shall conform to NEMA MG 1 Design B type. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

2.7 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed in accordance with NFPA 20. Controller shall be equipped with a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F Controller shall be equipped with a sequential start timer/relay feature to start multiple fire pumps in sequence.

2.7.1 Controller for Electric Motor Driven Fire Pump

Controller shall be electronic soft start starting type. Controller shall be designed as indicated. Controller shall have a short circuit rating as indicated. Controller shall monitor pump running, loss of a phase or line power, phase reversal and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 15 hp, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 200 horsepower and for 15 minutes for pumps with motors 200 horsepower and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

2.8 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inchH58 brass tubing complying with ASTM B135. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled

for a 3/32 inch. Restricted orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.9 PRESSURE MAINTENANCE PUMP

2.9.1 General

Pressure maintenance pump shall be electric motor driven, horizontal shaft centrifugal type with a rated discharge of 40 gpm at 160 psig. Pump shall draft as indicated and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

2.9.2 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

2.10 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. 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 B62. 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 A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 239 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 A183.

2.11 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump

for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inchgalvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 18-24 inchesreinforced concrete pad that is an integral part of the reinforced concrete floor.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s), no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.4 INSTALLATION REQUIREMENTS

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction. Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

3.5 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using

tapered reducing pipe fittings. Bushings shall not be used. Photograph all piping prior to burying, covering, or concealing.

3.5.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

3.5.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

3.5.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

3.5.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

3.5.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

3.5.4 Grooved Mechanical Joint

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 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.

3.6 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall match that of the existing and AFRC standards.

3.8 FLUSHING

The fire pump suction and discharge piping shall be flushed at 150 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. No underground piping shall be flushed by using the fire pumps. Flushing operations shall continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

3.9 FIELD TESTS

Submit, at least 2 weeks before starting field tests, system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and 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.Proposed diagrams, at least 2 weeks prior to start of related testing.

3.9.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psig for a period of 2-hours, or at least 50 psiin excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi in accordance with NFPA 20.

3.9.2 Preliminary Tests

Submit proposed procedures for Preliminary Tests, at least 14 days prior to the proposed date and time to begin Preliminary Tests. The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer (when supplied) shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including

trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. Submit 3 copies of the completed Preliminary Tests Reports, no later that 7 days after the completion of the Preliminary Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

3.9.3 Final Acceptance Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative (when supplied) shall also witness for the final tests. Repair any damage caused by hose streams or other aspects of the test. Submit proposed date and time to begin Final Acceptance Test, with the Acceptance Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Submit 3 copies of the completed Final Acceptance Test Reports, no later that 7 days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report. Notification shall include a copy of the Contractor's Material & Test Certificates. Include the following in the final acceptance test:

3.9.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.9.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting.

Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 200 horsepowershall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

3.9.3.3 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

3.9.3.4 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.9.3.5 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.9.3.6 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. All test data records shall be submitted in a three ring binder.

3.9.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The Contractor shall furnish water for the tests.

3.9.5 As-Built Drawings

Submit As-Built Drawings, no later than 14 days after completion of the Final Tests. The Fire Pump Installation Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

3.10 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic tests are successfully completed, thoroughly flush the pumps and all piping to be disinfected with potable water until there is no visible sign of dirt or other residue. and hydrostatic test are successfully completed, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material.

3.10.1 Chlorination

The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system.

3.10.2 Flushing

The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer.

3.10.3 Sample Testing

Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.11 FIELD TRAINING

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for field training at least 14 days prior to the start of related training. Training shall be provided for a period of 2 hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit 6 manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days 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. Data Package 3 shall be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

-- End of Section --

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
08/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Certification

1.3 RELATED REQUIREMENTS

This section applies to all sections of Divisions: 21, FIRE SUPPRESSION; 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.3 Service Support

The equipment items shall be supported by service organizations. Submit a

certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained

in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

-- End of Section --

SECTION 23 31 13.00 40

METAL DUCTS
11/12

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE EQUIP IP HDBK	(2012) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2009; Errata 2010) Fundamentals Handbook, I-P Edition

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition
SMACNA 1987	(2006) HVAC Duct Systems Inspection Guide, 3rd Edition

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 2480	(2009; Rev H) Phosphate Treatment, Paint, Base

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Painting Manual	(2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005; Reprint Oct 2008) Factory-Made Air Ducts and Air Connectors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists; G

Records of Existing Conditions; G

SD-02 Shop Drawings

Connection Diagrams; G

Record Drawings; G

Offset Fitting Configurations; G

SD-03 Product Data

Equipment and Performance Data; G

Galvanized Steel Ductwork Materials; G

Brazing Materials; G

Mill-Rolled Reinforcing and Supporting Materials; G

Round Sheet Metal Duct Fittings; G

Turning Vanes; G

Flexible Connectors; G

Flexible Duct Materials; G

Gravity Backdraft and Relief Dampers; G

SD-05 Design Data

Design Analysis and Calculations; G

SD-06 Test Reports

Ductwork Leakage Tests; G

Operational Tests; G

SD-07 Certificates

Listing of Product Installations; G

Galvanized Steel Ductwork Materials; G

Brazing Materials; G

Mill-Rolled Reinforcing and Supporting Materials; G

Round Sheet Metal Duct Fittings; G

Turning Vanes; G

Flexible Connectors; G

Operation and Maintenance Manuals; G

1.3 RECORD DRAWINGS

Provide record drawings with current factual information. Include

deviations from, and amendments to, the drawings and concealed or visible changes in the work, for medium/high pressure ductwork systems. Label drawings "As-Built".

PART 2 PRODUCTS

Include the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information within material, equipment, and fixture lists.

2.1 SYSTEM DESCRIPTION

Provide low-pressure systems ductwork and plenums where maximum air velocity is 2,000 feet per minute(fpm) and maximum static pressure is 2 inches water gage (wg), positive or negative.

Submit connection diagrams for low pressure ductwork systems indicating the relation and connection of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit design analysis and calculations for low pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressures, temperature calculations and acoustic levels.

Encompass high velocity systems ductwork where:

a. Minimum air velocity exceeds 2,000 feet per minute (fpm) or static pressure exceeds 2 inches water gage (wg).

B.

c.

d. Do not use rigid fibrous-glass ductwork.

2.1.1 Design Requirements

Submit records of existing conditions including the results of a survey consisting of work area conditions, and features of existing structures and facilities within and adjacent to the jobsite.

Submit equipment and performance data for medium/high pressure ductwork systems consisting of use life, system functional flows, safety features, and mechanical automated details. Submit test response and performance characteristics curves for certified equipment.

Submit design analysis and calculations for medium/high pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressure, and temperature calculations.

2.2 MATERIALS

2.2.1 Galvanized Steel Ductwork Materials

Provide hot-dip galvanized carbon steel ductwork sheet metal of lock-forming quality, with regular spangle-type zinc coating, conforming to ASTM A924/A924M and ASTM A653/A653M, Designation G90. Treat duct surfaces

to be painted by apostatizing.

Conform to ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966 for sheet metal gages and reinforcement thickness.

Low pressure ductwork minimum standards are:

MINIMUM SHEET METAL GAGE

DUCT WIDTH INCHES	GAGE
0 - 12	26
13 - 30	24
31 - 60	22

2.2.2 Brazing Materials

Provide silicon bronze brazing materials conforming to AWS A5.8/A5.8M.

2.2.3 Mill-Rolled Reinforcing And Supporting Materials

Conform to ASTM A36/A36Mfor mill-rolled structural steel and, wherever in contact with sheet metal ducting galvanize to commercial weight of zinc or coated with materials conforming to ASTM A123/A123M SSPC Painting Manual.

In lieu of mill-rolled structural steel, submit for approval equivalent strength, proprietary design, rolled-steel structural support systems.

2.3 COMPONENTS

2.3.1 Round Sheet Metal Duct Fittings

Submit offset fitting configurations for approval. Shop fabricate fittings.

2.3.1.1 Fittings Construction

Manufacture as separate fittings, not as tap collars welded or brazed into duct sections.

Provide two-piece type miter elbows for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Ensure centerline radius of elbows is 1-1/2 times fitting cross section diameter.

Provide conical type crosses, increasers, reducers, reducing tees, and 90-degree tees.

2.3.2 Turning Vanes

Provide double-wall type turning vanes, commercially manufactured for high-velocity system service.2.3.3 Flexible Connectors For Sheet Metal

Use UL listed connectors, 30-ounce per square yard, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, is 6 to 8 inches.

2.3.4 Duct Hangers

For duct hangers in contact with galvanized duct surfaces, provide galvanized steel painted with inorganic zinc.

2.3.5 Mill-Rolled Reinforcing And Supporting Materials

Provide mill-rolled structural steel conforming to ASTM A36/A36M. Whenever in contact with sheet metal ducting, provide galvanized steel in accordance with ASTM A123/A123M.

In lieu of mill-rolled structural steel, submit equivalent strength, proprietary-design, rolled-steel structural support systems for approval.

2.3.6 Flexible Duct Materials

Ensure flexible duct connectors comply with NFPA 90A, and conform with UL 181, Class 1 material.2.3.7 Gravity Backdraft And Relief Dampers

Construct frames of not less than 1-1/2- by 4 inch reinforced 16-gage galvanized carbon steel. Solidly secure frames and mullions in place and seal with elastomer caulking against air bypass.

Provide shaft bearings with oil-impregnated bronze.

Equip counterbalanced dampers with fixed or adjustable counterbalancing weights.

Gravity backdraft dampers may be equipment manufacturer's standard construction in sizes 18 by 18 inch or smaller, when furnished integral with air moving equipment.

2.3.7.1 Blade Construction

Maximum blade width is 9 inches, and maximum blade length is 36 inches. Blade material is 16-gage galvanized steel . Provide blades with mechanically retained seals and 90-degree limit stops.

Blades linked together for relief service dampers are to open not less than 30 degrees on 0.05 inch wg differential pressure.

PART 3 EXECUTION

3.1 PREPARATION

For sheet metal surfaces to be painted, and surfaces to which adhesives are to be applied, clean surface of oil, grease, and deleterious substances.

Ensure strength is adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Provide leaktight, automatic relief devices.

3.1.1 Construction Standards

Provide sheet metal construction in accordance with the recommendations for best practices in ASHRAE EQUIP IP HDBK, Chapter 16, SMACNA 1966, NFPA 90A, and ASHRAE FUN IP, Chapter 32.

Design and fabricate supplementary steel in accordance with AISC 360 and

AISC 325.

Where construction methods for certain items are not described in the referenced standards or herein, perform the work in accordance with recommendations for best practice defined in ASHRAE EQUIP IP HDBK.

3.2 INSTALLATION

When furnishing the listing of product installations for medium/high pressure ductwork systems include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include purchaser, address of installation, service organization, and date of installation.

Fabricate airtight and include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Provide offsets and transformations as required to avoid interference with the building construction, piping, or equipment.

Make plenum anchorage provisions, sheet metal joints, and other areas airtight and watertight by caulking mating galvanized steel and concrete surfaces with a two-component elastomer.

3.2.1 Jointing

Enclose dampers located behind architectural intake or exhaust louvers by a rigid sheet metal collar and sealed to building construction with elastomers for complete air tightness.

Provide outside air-intake ducts and plenums made from sheet metal with soldered watertight joints.

3.3 APPLICATION

3.3.1 Low Pressure Sheet Metal Ducts

Weld angle iron frames at corners and ends, whenever possible. Rivet or weld angle iron reinforcements to ducts not more than 6 inches on center, with not less than two points of attachment. Spot welding, where used, is 3 inches on center.

Seal standard seam joints with an elastomer compound to comply with SMACNA 1966 Seal Class A, B or C as applicable.

Limit crossbreaking to 4 feet and provide on all ducts 8 inches wide and wider. Provide bead reinforcement in lieu of crossbreaking where panel popping may occur. Where rigid insulation is applied, crossbreaking is not required.

3.3.1.1 Longitudinal Duct Seams

Provide Pittsburgh lock corner seams.

3.3.1.2 Joints and Gaskets

Bolt companion angle flanges together with 1/4 inch diameter bolts and nuts

spaced 6 inches on center. Gasket flanged joints with chloroprene full-face gaskets 1/8 inch thick, with Shore A 40 durometer hardness. Use one piece gaskets, vulcanized at joints.

3.3.1.3 Square Elbows

Provide single-vane duct turns in accordance with SMACNA 1966.

3.3.1.4 Radius Elbows

Conform to SMACNA 1966 for radius elbows. Provide an inside radius equal to the width of the duct. Where installation conditions preclude use of standard elbows, the inside radius may be reduced to a minimum of 0.25 times duct width and install turning vanes in accordance with the following schedule.

WIDTH OF ELBOWS INCHES	RADIUS OF TURNING VANES IN PERCENT OF DUCT WIDTH VANE NO. 1	VANE NO. 2	VANE NO. 3
Up to 16	56	--	--
17 to 48	43	73	--
49 and over	37	55	83

Where two elbows are placed together in the same plane in ducts 30 inches wide and larger, continue the guide vanes through both elbows rather than spaced in accordance with above schedule.

3.3.1.5 Duct Transitions

Where the shape of a duct changes, ensure the angle of the side of the transition piece does not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, ensure the angle of the side of the transition piece from the straight run of duct connected thereto does not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.1.6 Plenum Construction

Provide intake and discharge plenum companion angle joints with the following minimum thickness of materials:

LONGEST ANGLES SIDE INCHES	SHEET METAL USS GAGE ALL SIDES	COMPANION ANGLES INCHES	REINFORCEMENT INCHES, 24 INCHES ON CENTER MAXIMUM
To 48	20	1-1/2 by 1-1/2 by 1/8	1-1/2 by 1-1/2 by 1/8
49 to 84	18	2 by 2 by 1/8	2 by 2 by 3/16
85 to 120	16	2 by 2 by 1/8	2 by 2 by 1/8
121 and larger	14	2 by 2 by 3/16	2 by 2 by 3/16

At the floor line and other points where plenums join masonry construction, bolt panels 12 inches on center to 2- by 2- by 3/16 inch thick hot-dip galvanized steel angle that has been secured to the masonry with masonry anchors and bolts 24 inches on center and caulked tight to the masonry.

Anchor panels to curbing by not less than 2- by 2- by 3/16 inch thick hot-dip galvanized steel angle iron. Concrete curbing includes angle iron nosing with welded studs for the anchoring of panels. Level nosing at curb height within plus or minus 1/16 inch.

Weld and grind miter corners for angle iron and channel iron.

3.3.2 Rectangular Sheet Metal Ducts

3.3.3 Round Sheet Metal Ducts

3.3.3.1 Duct Gages And Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Provide ducts with supplemental girth angle supports, riveted with brazed to duct. Locate girth angles as follows:

DIAMETER, INCHES	REINFORCEMENT-MAXIMUM SPACING, INCHES
25 to 36	1-1/4 by 1-1/4, 1/8 thick, 72 inches on center
37 to 50	1-1/4 by 1-1/4, 1/8 thick, 60 inches on center
51 to 60	1-1/2 by 1-1/2, 1/8 thick, 48 inches on center

Bolt heads and nuts shall be hex-shaped, 5/16 inch diameter for ducts up to 50 inch diameter, and 3/8 inch diameter for 51 inch diameter ducts and larger.

Braze flanges to duct on outside of duct and intermittently welded with 1 inch welds every4 inches on inside joint face. Remove excess filler metal from inside face. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

3.3.3.2 Duct Joints

Provide duct joints manufactured by machine, with spiral locksets to and including 60 inch diameters, and to dimensional tolerances compatible with fittings provided. Draw band girth joints are not acceptable.

Prepare slip joints by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Use sheet metal screws to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Do not use pop rivets. Tape and heat seal all joints.

3.3.3.3 Duct Transitions

Where equipment is installed in ductwork, ensure the angle of the side of the transition piece from the straight run of duct connected thereto does not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.4 Transverse Reinforcement Joints

Provide transverse reinforcements that are riveted with solid rivets to duct sides 6 inches on center . Weld transverse reinforcement at ends to form continuous frames.

3.3.5 Joint Gaskets

Gasket flanged joints with chloroprene full-face gaskets 1/8 inch thick, Shore A 40 durometer hardness. Use one-piece gaskets, vulcanized at joints.

3.3.6 Radius Elbows

Fabricate elbow proportions and radius elbows in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

3.3.7 Plenum Connections

Ensure round duct connections are welded joint bellmouth type.

Ensure rectangular duct connections are bellmouth type, constructed in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

3.3.8 Duct Supports

Install duct support in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Meet the minimum size for duct hangers as specified in ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Provide two hangers where necessary to eliminate sway. Support attachment to duct surfaces by solid rivet 4 inches on center.

Take the following into account in selection of a hanging system:

a. Location and precedence of work under other sections

b. Interferences of various piping and electrical conduit

c. Equipment,and building configuration

d. Structural and safety factor requirements

e. Vibration, and imposed loads under normal and abnormal service conditions

Support sizes, configurations, and spacing are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories reduce hanger spacing. After system startup, replace any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, or the condition otherwise be alleviated. Exercise special care to

preclude cascade-type failures.

Do not hang ductwork and equipment from roof deck, piping, or other ducts or equipment. Maximum span between any two points is 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

Where support from metal deck systems is involved, coordinate support requirements with installation of metal deck.

3.3.8.1 Hangars

Attach hanger rods, angles, and straps to beam clamps. Receive approval from the Contracting Officer for concrete inserts, masonry anchors, and fasteners for the application.

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements. Make fasteners from steel conforming to AISI Type 1055 , treated and finished in conformance with SAE AMS 2480, Type Z (zinc phosphate base), Class 2 (supplementary treatment). Verify a 72-hour load-carrying capacity by a certified independent laboratory.

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, hang such equipment independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Sufficiently cross-brace hangers to eliminate swaying both vertically and laterally.

3.3.8.2 Installation

Ensure hanger spacing gives a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners is 100 pounds.

Install hangers on both sides of all duct turns, branch fittings, and transitions.

Friction rod assemblies are not acceptable.

3.3.8.3 Strap-type Hangars

Support rectangular ducts up to 36 inches by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

3.3.8.4 Trapeze Hangars

Support rectangular ducting, 36 inches and larger, by trapeze hangers. Support ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing on trapeze hangers. Space hangers far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside the trapeze. Do not penetrate the vapor-sealed facing with duct hangers.

Where trapeze hangers are used, support the bottom of the duct on angles sized as follows:

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8
49 to 72	1-1/2 by 1-1/2 by 3/16
73 to 96	2 by 2 by 1/4
97 and wider	3 by 3 by 1/4

3.3.8.5 Purlins

Do not support ducting, when supported from roof purlins, at points greater than one-sixth of the purlin span from the roof truss. Do not exceed 400 pounds load per hanger when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load is the product of 400 times the inverse ratio of the longest distance of purlin-to-purlin spacing.

When the hanger load exceeds the above limits, provide reinforcing of purlin(s) or additional support beam(s). When an additional beam is used, have the beam bear on the top chord of the roof trusses, and also bear over the gusset plates of top chord. Stabilize the beam by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays are considered fully loaded. Provide supplemental reinforcing or auxiliary support steel for these purlins.

3.3.9 Insulation Protection Angles

Provide galvanized 20-gage sheet, formed into an angle with a 2 inch exposed long leg with a 3/8 inchstiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness.

Install angles over all insulation edges terminating by butting against a wall, floor foundation, frame, and similar construction. Fasten angles in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Install angles after final insulation covering has been applied.

3.3.10 Openings In Roofs And Walls

Building openings are fixed and provide equipment to suit.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspection

Inspect ductwork in accordance with SMACNA 1987.

3.5 OPERATION AND MAINTENANCE

Submit 6 copies of the operation and maintenance manuals 30 calendar days prior to testing the medium/high pressure ductwork systems. Update data and resubmit for final approval no later than 30 calendar days prior to contract completion.

Ensure Operation and Maintenance Manuals are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

SECTION 23 37 13.00 40

DIFFUSERS, REGISTERS, AND GRILLS
05/10

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 OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 113	(2013) Method of Testing for Room Air Diffusion
ASHRAE EQUIP IP HDBK	(2012) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2009; Errata 2010) Fundamentals Handbook, I-P Edition

1.2 PERFORMANCE REQUIREMENTS

Certify air diffusion devices having been tested and rated in accordance with , Chapter 17; , Chapter 31; ASHRAE EQUIP IP HDBK, Chapter 17; ASHRAE FUN IP, Chapter 31; and ASHRAE 113, where such certification is required.

Submit equipment and performance data for air-diffusion devices consisting of sound data in terms of Noise Criteria (NC) index for the capacity range of the device.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists; G

Records of Existing Conditions; G

SD-02 Shop Drawings

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

SD-04 Samples

Manufacturer's Standard Color Chart; G

SD-10 Operation and Maintenance Data

Type GR Supply Troffer; G

PART 2 PRODUCTS

2.1 AIR-DIFFUSION DEVICE CONSTRUCTION

Preclude flutter and rattle on air-diffusion device construction and mounting. Modify devices and provide accessories necessary for mounting in indicated surface construction.

Select color from manufacturer's standard color chart which indicate the manufacturer's standard color selections and finishes for air-diffusion devices.

Include within the material, equipment, and fixture lists the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit fabrication drawings for air-diffusion devices consisting of fabrication and assembly details to be performed in the factory.

2.2 TYPES OF AIR-DIFFUSION DEVICES

2.2.1 Type GR

Provide type GR return grills, single deflection type with fixed face bars.

Provide grills installed in vertical surfaces with horizontal face bars set downward at 35 degrees from vertical.

Provide grills installed in horizontal surfaces with face bars straight and parallel to short dimension.

Provide aluminum construction.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment as indicated and specified and in accordance with manufacturer's recommendations.

Submit installation drawings for air-diffusion devices. Indicate on drawings overall physical features, dimensions, ratings, service requirements, and equipment weights.

3.1.1 Operations and Maintenance Manuals

Provide operation and maintenance manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

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.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012; INT 3 2012) National Electrical Safety Code
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS . This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 05 13.00 40 MEDIUM-VOLTAGE CABLES
Section 26 05 19.00 10 INSULATED WIRE AND CABLE
Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES
Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

Section 26 08 00 APPARATUS INSPECTION AND TESTING
Section 26 12 19.00 40 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 28 21.00 40 AUTOMATIC TRANSFER SWITCHES
Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 12.47 kV primary, three phase, three wire, 60 Hz, and 4160 volts secondary, three phase, three wire. Final connections to the power distribution system at the existing manhole shall be made by the Contractor as directed by the Government.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on each side of the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.2 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL
11/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	(2006; R 2011) American National Standard for Safety--Color Code
ANSI/NEMA OS 1	(2008; Amd 2010) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA FB 1	(2012) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and

	Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siren, loudspeaker or other device. All components of a

vertical assembly will be rated by the manufacturer to withstand 135 mph wind loading.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, for the following:

Conduits, Raceways and Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Pad-mounted, liquid-filled, medium-voltage Transformers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceways and Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Pad-mounted, liquid-filled, medium-voltage Transformers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 GENERAL REQUIREMENTS

Submit material, equipment, for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.5 inch high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER

HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.Mount sign on all sides of the fence.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.1.8 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN and copper 15KV type. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be solid.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved indentor crimp-type connectors and compression tools.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools . Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 42,000 amperes root-mean-square (rms) symmetrical at 480 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.8 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

Oil-insulated, medium-voltage transformers with two-winding, 60 hertz, self-cooled type and copper windings.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed through concrete walls for connections to free-standing equipment. Conduits installed for future use shall be terminated with a coupling and plug set flush with the wall .

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit (if necessary) to connect from rigid conduit or electrical metallic conduit to the fire alarm controllers amd from the fire alarm controllers to the fire pumps. .

Bonding wires shall be used in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.5 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

3.1.6 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.1.7 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by one hanger. Trays greater than 10-inches wide shall be supported by two hangers. Bond cable trays at splices.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC
Phase A	Brown

CONDUCTOR	COLOR AC
Phase B	Orange
Phase C	Yellow
Neutral	White
Equipment Grounds	Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops and laboratories	48 inches
Receptacles in rest rooms	48 inches
Switches for light control	48 inches

3.6 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted.

3.8 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION 26 05 13.00 40

MEDIUM-VOLTAGE CABLES
08/10

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.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS1	(1990e11) Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM D 746	(2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004
IEEE 400.2	(2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 71/ICEA S-96-659	(1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	(2006) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution

of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code

1.2 DEFINITIONS

Medium voltage power cables includes all cables rated above 600 to 35,000 volts.

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Provide Certificates for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Provide certified copies of test data that shows conformance with the referenced standards and is approved prior to delivery of cable.

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 reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Provide equipment and performance data and manufacturer's catalog data for the following items:

Single-Conductor Shielded Cables

SD-06 Test Reports

Provide test reports for the following in accordance with the paragraph entitled, "Field Testing," of this section.

Dielectric Absorption Tests

High-Voltage Tests

SD-07 Certificates

Provide listing of products installed showing qualifications of Cable Splicers to the Contracting Officer prior to specified work.

Provide Certificates for the following:

Flammability

Minimum Bending Radius

High-Voltage Tests

Dielectric Absorption Tests

Cable Splicers

SD-08 Manufacturer's Instructions

Provide manufacturer's instructions showing the recommended sequence and method of installation for the following:

Medium-Voltage Power Cables

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 QUALIFICATIONS

Cable splicers performing splicing are required to have 5 years experience in cable splicing and terminations. Once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work period.

1.7 CABLE VOLTAGE RATINGS

Provide Medium-voltage power cables including multiple- and single-conductor cables rated as follows, phase-to-phase, for grounded and ungrounded neutral systems:

Use cables rated 15,000 volts, , on 12,470-volt, three-phase,

60-hertz distribution systems.

1.8 SHIPMENT

Ship cables on reels such that the cable is protected from mechanical injury. Hermetically seal and securely attach each end of each length of cable to the reel.

Make minimum reel drum diameter 14 times the overall diameter of the cable. Provide a pulling eye that is installed by the manufacturer for each length of cable supplied for installation in ducts, manholes, and utility tunnels.

PART 2 PRODUCTS

2.1 CONDUCTORS

Provide conductors that are solid copper conforming to ASTM B3.

2.2 CABLE IDENTIFICATION

Provide cables that have a fire tape placed immediately under the lead sheath or outer jacket showing the name of the manufacturer, the year in which the cable was manufactured, feeder size, type of cable, destination of cable and a unique number for identification purposes. Closely group information on the tape at 1-foot intervals to permit complete identification.

2.3 FLAMMABILITY

Test cables not to be enclosed in metallic conduit for flammability in accordance with IEEE 383, 70,000 Btu per hour per hour vertical tray flame test.

2.4 SINGLE-CONDUCTOR SHIELDED CABLES

2.4.1 Ethylene-Propylene-Rubber-Insulated with PVC Jacket

Provide single-conductor 15 KV cable assemblies that consist of: Class B stranded copper conductors, an extruded semiconducting shield over the conductors, 220 mils of ethylene propylene rubber insulation, an extruded or other approved semiconducting shield, a 5 mil minimum copper tape shield wrapped helically with a minimum 12.5 percent overlap and a PVC jacket.

Provide single-conductor, ethylene-propylene-insulated, polyvinylchloride-jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.

2.5 CABLE SUPPORTS AND FITTINGS

Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory applied coating of polyvinylchloride of at least __20___ mils thick. Provide polyvinylchloride (PVC) coated items that have a uniform thickness and be free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D 746.

PART 3 EXECUTION

3.1 INSTALLATION

Install medium-voltage cables in accordance with NFPA 70.

Install cable in underground duct banks; in conduit above and below grade; inside buildings; by open wire method; on insulator hooks; on racks; in wall and ceiling mounted cable trays in utility tunnels and manholes;

Secure cables with heavy duty cable ties in existing or new trays mounted horizontally, where cable rests on tray bottom. Install cable ties at minimum of __10___ foot intervals.

Secure cables with PVC coated cable clamps, straps, hangers, or other approved supporting devices to tunnel walls, ceilings, and in new or existing cable trays mounted vertically, where tray bottom is in a vertical plane.

When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure the absence of voids, pinholes, or cuts.

Ensure that all cable tray is properly secured and supported prior to installing new armored cable. Add new permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.

Cable or conductors of a primary distribution system will be rejected when installed openly in cable trays or openly racked along interior walls; in the same raceway or conduit with ac/dc control circuits or ac power circuits operating at less than 600 volts; or in a manner allowing cable to support its own weight.

3.1.1 Moisture-Testing Before Pulling

Moisture-test cable that has paper insulation before pulling it into underground ducts. Ensure that radii of bends, potheads, fittings, cable risers, and other conditions are suitable for the cable and conform with the recommendations of the cable manufacturer.

3.1.2 Protection During Splicing Operations

Provide blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Make waterproof protective coverings available on the work site to provide protection against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Moisture-test conductor insulation paper before the splice is made. Use a manhole ring at least __6___-inches above ground around the manhole entrance to keep surface water from entering the manhole. Plug unused ducts and stop water seepage through ducts in use before the splice is started.

3.1.3 Duct Cleaning

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth,

sand, or foreign material in the line. Provide not less than __12___ -inches long mandrel with a diameter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Provide brush diameter that is the same as or slightly larger than the diameter of the duct.

3.1.4 Pulling Cables in Ducts, Manholes and Utility Tunnels

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure the careful and proper installation of the cable.

Set up cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member.

Allow for a pulling force for a cable grip on lead-sheathed cable that does not exceed 1,500_____ pounds per square inch of sheath cross-sectional area. Use a dynamometer in the pulling line to ensure that the pulling force is not exceeded. Allow for a pulling force for a nonmetallic-sheathed cable that does not exceed the smaller of 1,000 pounds or a value computed from the following equation:

TM = 0.008 X N X CM

Where: TM = maximum allowable pulling tension in pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in circular mils

Unreel cable from the top of the reel. Carefully control payout. Make cable to be pulled be attached through a swivel to the main pulling wire by means of a suitable cable grip permitted only on cables less than 200-feet long and less than 2 inches in diameter.

Use woven-wire cable grips to grip the cable end when pulling small cables and short straight lengths of heavier cables.

Attach pulling eyes to the cable conductors to prevent damage to the cable structure.

Use pulling eyes and cable grips together for nonmetallic sheathed cables to prevent damage to the cable structure.

Provide a minimum bending radius in accordance with the following:

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER
RUBBER- AND PLASTIC-INSULATED CABLE WITH OR WITHOUT INTERLOCKED ARMOR	

CABLE TYPE	MINIMUM BENDING RADIUS MULTIPLIER TIMES CABLE DIAMETER
Shielded cables with shielding tape	12

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Use grease and oil lubricants only on lead-sheathed cables. Cover nonmetallic sheathed cables with wire-pulling compounds when required which have no deleterious effects on the cable. Provide rollers, sheaves, or tube guides around which the cable is pulled that conform to the minimum bending radius of the cable.

Pull cables into ducts at a speed not to exceed _50____ feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not permitted. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

Make cable splices made up in manholes or utility tunnels that are firmly supported on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Make cables to be spliced in manholes or utility tunnels overlap the centerline of the proposed joint by not less than __2___ feet.

Provide cables cut in the field that have the cut ends immediately sealed to prevent entrance of moisture. Seal nonleaded cables with rubber tape wrapped down to __3___ inches from the cable end. Cover-wrap rubber tape with polyvinylchloride tape. Seal lead-covered cables with wiping metal making a firm bond with the end of the sheath or with a disk of lead fitted over the end and wiped to the sheath.

3.1.5 Splices and Terminations

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

Terminate cables in potheads. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones are allowed for terminating cables. Provide potheads with adequate means for making external connections to the cable conductors of single-and multiple-conductor cables; protecting the cable insulation against moisture, oil, or other contaminant; physically protecting and supporting cables, and maintaining the insulation level of the cable.

Field-fabricate from termination kits supplied by and in accordance with the pothead manufacturer's recommendations for the type, size, and electrical characteristics of the cable.

Installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above,

ungrounded.

Field fabricate cable splices from splicing kits supplied by and in accordance with the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

Cable splices in the tunnel which are not installed in cable trays, install on cable racks or by other approved methods which minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in such manner so as to minimize physical stress on the splice connections. Support each cable end termination using a pair of saddle type supports under the cable end termination and/or cable with a minimum _12____ inches and a maximum __30 ___ inches separation between the supports. Secure cable end termination and cable to the supports in such a manner as to prevent movement of termination or cable at the support. Install saddle type supports on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Subject each to dielectric-absorption tests and high-voltage tests after the installation has been completed, including splices, joints, and terminations, and before the cable is energized.

Provide test equipment, labor, and technical personnel as necessary to perform the electrical acceptance tests.

Make arrangements to have tests witnessed and approved by the Contracting Officer.

Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

First give each power cable a full dielectric-absorption test with 5000-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct readings taken at other than 68 degrees F ambient temperatures.

Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with AEIC CS1 and IEEE 400.2 for paper-impregnated, lead-covered cable; AEIC C8 and IEEE 400.2 for cross-linked, polyethylene-insulated cable; and AEIC C8 and IEEE 400.2 for ethylene propylene rubber-insulated cable.

Record leakage current readings every 30 seconds during the first 2 minutes

and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.

Record test data and include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Contracting Officer Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 26 05 19.00 10

INSULATED WIRE AND CABLE
11/08

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.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 383	(2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation Instructions

SD-06 Test Reports

Tests, Inspections, and Verifications

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in

paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above shall be reeled and marked in accordance with Section I of AEIC C8 or AEIC CS8, as applicable. Reels shall remain the property of the Government.

1.4 PROJECT/SITE CONDITIONS

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Furnish wire and cable in accordance with the requirements of the wire table below, conforming to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 70.

2.1.3 Conductors

2.1.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of NEMA WC 70, as applicable, and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 18 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in NEMA WC 70, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in NEMA WC 70, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Use conductor shielding conforming to NEMA WC 70, as applicable, on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC C8 or AEIC CS8. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied

insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material

Provide insulation which is a ethylene-propylene rubber (EPR) type meeting the requirements of NEMA WC 70. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply:

a. XLPE, if used, shall be tree-retardant.

b. Insulation shall be chemically bonded to conductor shielding.

c. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC C8 or AEIC CS8, as applicable.

d. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable .

2.1.4.2 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated circuit voltage.

a. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by NEMA WC 70, as applicable. Some thicknesses of NEMA WC 70 will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 70 ethylene-propylene rubber-insulated conductors shall have a jacket.

b. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with the following:

(1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with NEMA WC 70, as applicable.

(2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC C8 or AEIC CS8, as applicable.

c. Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by NEMA WC 70, as applicable.

2.1.4.3 Insulation Shielding

Unless otherwise specified, provide insulation shielding for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in NEMA WC 70, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC C8 or AEIC CS8, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC C8 or AEIC CS8, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of NEMA WC 70, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Polyvinyl chloride compounds will not be permitted.

a. General Use

(1) Heavy-duty black neoprene (NEMA WC 70).

(2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 70).

(3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 70).

b. Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

(1) General-purpose neoprene (NEMA WC 70).

(2) Black polyethylene (NEMA WC 70).

(3) Thermoplastic chlorinated polyethylene (NEMA WC 70).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below.

a. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by NEMA WC 70, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by NEMA WC 70.

b. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in NEMA WC 70. If shielded, the jacket thickness shall be in accordance with the requirements of NEMA WC 70.

2.1.6 Metal-Clad Cable

2.1.6.1 General

The metallic covering shall be corrugated metal, conforming to the applicable requirements of NEMA WC 70. If the covering is of ferrous metal, it shall be galvanized. Copper grounding conductor(s) conforming to NEMA WC 70 shall be furnished for each multiple-conductor metal-clad cable. Assembly and cabling shall be as specified in paragraph CABLING. The metallic covering shall be applied over an inner jacket or filler tape. The cable shall be assembled so that the metallic covering will be tightly bound over a firm core.

2.1.6.2 Jackets

Metal-clad cables may have a jacket under the armor, and shall have a jacket over the armor. Jackets shall comply with the requirements of NEMA WC 70. The outer jacket for the metal-clad cable may be of polyvinyl chloride only if specifically approved.

2.2 CABLE IDENTIFICATION

2.2.1 Color-Coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with NEMA WC 70, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with NEMA WC 70 . Power cable color-coding shall be brown for Phase A,orangefor Phase B, yellow for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included. Other individual conductors shall be color-coded as indicated on the contract drawings

2.2.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC C8 or AEIC CS8, as

applicable.

2.2.3 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to NEMA WC 70, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.4 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit cable manufacturing data as requested. The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished:

a. Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable.

b. Pulling tension and sidewall pressure limits, in pounds.

c. Instructions for stripping semiconducting insulation shields, if furnished, with minimum effort without damaging the insulation.

d. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

3.2.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the Contracting Officer. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

3.2.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be

witnessed by the Contracting Officer or his authorized representative, unless waived in writing. The Government may perform further tests before or after installation. Testing in general shall comply with NEMA WC 70. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below. Submit _6___ certified copies of test reports.

3.2.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

3.2.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC C8 or AEIC CS8 as applicable, unless otherwise stated.

a. High potential test voltages shall be as required by Table B1 of AEIC C8 or AEIC CS8 as applicable, rather than by NEMA WC 70.

b. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes.

c. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area.

d. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

3.2.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 70. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

3.2.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with

acceptable values for the application, will be grounds for rejection of the cable.

3.2.2.5 Reports

Furnish results of tests made. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

WIRE TABLE

Item No.	Size, AWG or kcmil	No. of Conds.	Rated Circuit Voltage	Stranding	Comments	Quantity lin ft.
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Class ___ stranding may be substituted for ___ where indicated by "*".

-- End of Section --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
10/07

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2011) Steel Construction Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007; Change 1) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008; Reprint Jan 2010) Luminaires

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Switchgear
Light Fixtures	Unit Substations
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	Storage Racks
_ATS____	Solar Heating Units

1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

1.2.4 Contractor Designed Bracing

Submit copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from

the brace. Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor: _none____.

1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size . All other interior conduit, shall be seismically protected as specified.

1.3 EQUIPMENT REQUIREMENTS

Submit detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail, indicating thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment: to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Substations
Transformers
Switch Boards and Switch Gears

Free Standing Electric Motors
_ATS____

1.3.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished: shall be constructed and assembled to resist a horizontal lateral force of times the operating weight of the equipment at the vertical center of gravity of the equipment.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control

approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Equipment Requirements

SD-03 Product Data

Equipment Requirements; G
Contractor Designed Bracing; G

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe.

-- End of Section --

SECTION 26 05 70.00 40

HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES
11/11

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 C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

ASTM INTERNATIONAL (ASTM)

ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443	(1979) NARM Standard for Solid State Relays Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.09	(1999; AMD 1 2005; Corr 1 2007; R 2007; Errata 2007; Amendment B 2011) Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.121	(2012) American National Standard for Switchgear-Unit Substations - Requirements
IEEE C37.13	(2008; INT 1 2009; AMD 1 2012) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers
IEEE C37.17	(2012) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus

IEEE C57.13	(2008; INT 2009) Standard Requirements for Instrument Transformers

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C78.23	(1995; R 2003) American National Standard for Incandescent Lamps - Miscellaneous Types
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA SG 2	(1993) Standard for High-Voltage Fuses

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1999; Reprint May 2013) Industrial Control Equipment

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 reviews the submittal for the Government. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fuses; G

Sample Warranty; G

SD-02 Shop Drawings

Control Devices; G

Protective Devices; G

SD-03 Product Data

Enclosures; G

Circuit Breakers; G

Control Devices; G

Protective Relays; G

SD-06 Test Reports

Dielectric Tests; G

Timing Test; G

Final Test Reports; G

SD-07 Certificates

Circuit Tests; G

Warranty; G

SD-08 Manufacturer's Instructions

Control Devices; G

Protective Devices; G

SD-10 Operation and Maintenance Data

Circuit Breakers; G

Protective Relays; G

Indicating Instruments; G

1.3 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Prior to the beginning of construction submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details:

a. Fuses

d. Enclosures

e. Circuit breakers

f. Control devices

g. Protective relays

h. Indicating instruments

j. Submit diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

k. Submit drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

l. Submit manufacturer's sample warranty for review and acceptance to the Contracting Officer

1.4 QUALITY ASSURANCE

1.4.1 Predictive Testing And Inspection Technology Requirements

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Provide motor controllers conforming to NEMA ICS 3, and UL 508. Provide controllers that have thermal overload protection in each phase.

2.1.1 Magnetic Motor Controllers

2.1.1.1 Full-Voltage Controllers

Provide magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors with full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508.

Provide a coil assembly which operates satisfactorily between 85 and 110 percent of rated coil voltage, with 120 volts, 60 hertz motor control circuits, and with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits. Include solderless pressure wire terminal connectors for line-and load connections to controllers.

Overcurrent protection includes three manual reset thermal overload devices, one in each pole of the controller. Provide thermal overload relays of the melting-alloy type with continuous current ratings and service-limit current ratings and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. Ensure after the controller has tripped from overload, resetting the motor-overload device will not restart the motor.

Provide enclosure conforming to NEMA 250, Type 1.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

a. Contain equipment installed inside clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

b. Contain equipment installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.2.3 CIRCUIT BREAKERS

Provide circuit breakers conforming to UL 489, UL 489, and NEMA AB 3.

2.3.1 Power Circuit Breakers

Provide air-break type power circuit breakers enclosed in ventilated housings for those rated below 600 volts with current, voltage, and interrupting ratings as required.

Comply with IEEE C37.16 and IEEE C37.13 for power circuit breakers.

Equip power circuit breakers with electromechanical devices with instantaneous elements.Provide breakers that are electrically and mechanically trip-free in any position of the closing stroke. Include ground fault protection in either type trip device. Provide silver-plated main contacts and sintered tungsten alloy arcing contacts. Accomplish tripping by a shunt-trip device. Provide manual closing operation.

Provide drawout type breakers where installed in metal housings such as unit substations. For breakers installed in isolated locations or not as units of a central distribution center, provide wall -mounted, with a correctly ventilated protective metal cover.

Supply alarms, auxiliary switches, interlocks, and similar devices as required.

Provide breakers with a removable operating handle, provision for padlocking, and position indicator.

Submit certification of factory testing of Power Circuit Breakers in accordance with IEEE C37.09.

2.3.2 Air Circuit Breakers

Provide circuit breakers that include a ground-fault system or ground-sensing relays.

2.3.2.1 Stored-Energy-Operated Type

For air circuit breakers with stored-energy-operated mechanisms, conform to IEEE C37.121 for metal-clad switchgear rated above 600 volts , 14.4 kilovolts .

Mount metal-clad air circuit breakers on a mobile frame with primary and secondary disconnecting devices, automatic shutters, and mechanical interlocks to allow complete removal of the unit for inspection and maintenance. Provide three-pole, single-throw, electrically operated circuit breakers, with a motor-charged spring, stored-energy mechanism, and electric release coils for tripping and closing operations.

Provide a motor-operated position-changing mechanism that moves the breaker between the test and operating position by means of a levering device.

Provide interlocks to prevent the complete withdrawal of the circuit breaker from its compartment when the stored-energy mechanism is in the fully charged position. Design circuit breakers to prevent the release of stored energy unless the mechanism is fully charged.

Provide circuit breakers that have mechanically trip-free mechanisms with direct-current potential trip coils of the voltage indicated, auxiliary switches, latch-checking switches, control relays, and operation counters.

2.3.2.2 Solenoid-Operated Type

Conform to IEEE C37.121 for air circuit breakers with solenoid-operated mechanisms and the appropriate articles for metal-clad switchgear rated above 600 volts .

Mount metal-clad air circuit breakers on a mobile frame with primary and secondary disconnecting devices, automatic shutters, and mechanical interlocks to allow complete removal of the unit for inspection and maintenance. Provide three-pole single-throw circuit breakers, with solenoid-operated tripping/closing mechanism designed for operation on a direct-current station battery power supply or direct from an emergency ac power system of 15KV voltage.

Rate mechanism closing coils for 125 volts and operable at voltages as low as 90 volts. Rate mechanism trip coils for 125 volts and operable at voltages as low as 70 volts. Provide operating mechanism for ac control circuits by the manufacturer for voltage.

Provide circuit breakers with mechanically trip-free mechanisms including auxiliary switches, latch-checking switches, control relays, and operation counters. The use of solid-state tripping devices is acceptable.

2.4 FUSES

Provide a complete set of fuses for all switches and switchgear. Provide fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Provide power fuses on ac systems above 600 volts in accordance with NEMA SG 2.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or

pressed fiber for field installation.

2.5 PROTECTIVE RELAYS

2.5.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults provide single-phase nondirectional removable induction type overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required and indicating instantaneous-trip attachments with adjustable current range as required.

Provide lock-out relay in controller to prevent reset of the system.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

2.5.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For directional overcurrent relays for protection against reverse-power faults provide single-phase induction type with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.5.3 Reclosing Relays

For reclosing relays, conform to IEEE C37.90.

Design reclosing relays to reclose circuit breakers that have tripped from overcurrent. Provide device that automatically recloses the breaker at adjustable time intervals between reclosures and then locks out the breaker in the open position if the fault persists. Provide circuit breaker that remains closed and the reclosing relay resets automatically and is ready to start a new sequence of operation if the fault disappears after any reclosure.

Provide removable reclosing relays with built-in testing facilities and consisting of a timing unit rated at 120/240 volts, single-phase, ac and solenoid and contactor units with dc rating as indicated. Arrange contacts for one instantaneous reclosure and two subsequent reclosures at 15 and 45 seconds, respectively. Set time dial for 60-second drum speed.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.5.4 Undervoltage Relays

For undervoltage relays, conform to IEEE C37.90.

Provide three-phase induction type undervoltage relays including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Equip relays with indicating contactor and voltage switches to provide electrically separate contact circuits. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.6 INDICATING INSTRUMENTS

2.6.1 Ammeters

For ammeters, conform to ANSI C39.1.

Provide switchboard indicating ammeters of approximately 4-1/2 inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 5-ampere type meter for a zero to full-scale normal movement, 60 hertz.

2.6.2 Voltmeters

For voltmeters, conform to ANSI C39.1.

Provide a switchboard indicating voltmeters that is approximately 4-1/2-inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 120-volt type voltmeter for a zero to full-scale normal movement, 60 hertz.

2.7 FACTORY TESTING

Submit certification of factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1 and submit to the Contracting Officer.

Submit certification of factory tests on power, high-voltage, and oil circuit breakers in accordance with IEEE C37.09.

2.8 INDICATING LIGHTS

2.8.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.8.2 Switchboard Indicating Lights

For switchboard indicating lights, provide the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Provide indicating lights that are capable of being relamped from the switchboard front. Indicating lights utilizing resistors in series with the lamps are not permitted, except in direct-current control circuits. Provide lights that have a press-to-test feature.

2.9 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations.

PART 3 EXECUTION

3.1 INSTALLATION

Install control devices and protective devices that are not factory

installed in equipment in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1, NEMA ICS 2, and NEMA ICS 3 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Give circuit breakers rated 15KV and above a timing test to verify proper contact speed, travel, bounce, and wipe.

.

Perform and submit dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Submit final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

3.3 OPERATION AND MAINTENANCE MANUALS

No less than 30 days prior to final testing and inspection, submit Operation and Maintenance Manuals to the Contracting Officer for the following equipment:

a. Manual motor controllers

b. Magnetic motor controllers

c. High voltage motor controllers

d. Circuit breakers

e. Protective relays

f. Indicating instruments

3.4 WARRANTY

No less than 30 days prior to project completion, submit warranty to the Contracting Officer for final review.

-- End of Section --

SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES
05/11

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.

ASTM INTERNATIONAL (ASTM)

ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13	(2008; INT 2009) Standard Requirements for Instrument Transformers

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330	(1992) Design Guide Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2013) Molded-Case Circuit Breakers,

	Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1999; Reprint May 2013) Industrial Control Equipment

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 reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details..

Fuses

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices
Protective Devices

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control

Enclosures
Circuit Breakers
Control Devices

SD-07 Certificates

Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Manual Motor Controllers
Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Manual Motor Controllers

Provide full-voltage, manually operated manual motor controllers for the control and protection of single-phase 60-hertz ac fractional-horsepower squirrel-cage induction motors.

Provide single-throw, single- or double-pole, three-position controllers rated at not more than 1 horsepower at 115- and 230-volts single phase. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Provide controllers that clearly indicate operating condition: on, off, or tripped.

Provide toggle- or key-operated type manual motor controllers as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Provide recessed manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors, that include a single controller and indicating light in a 4-inch square wall outlet box, for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Provide surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 general-purpose enclosure.

Provide recessed and surface-mounted manual motor controllers for two-speed, fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices, with matching corrosion-resistant steel flush-cover plate. Provide surface-mounted manual motor controllers for two-speed fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a NEMA 250, Type 1 general-purpose enclosure.

2.1.2 Magnetic Motor Controllers

2.1.3 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers."for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, and NEMA AB 3.

2.3.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

2.3.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and UL 489.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.

Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

2.4 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.5 CONTROL DEVICES

2.5.1 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.5.2 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120 -volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.5.3 Pushbuttons and Switches

2.5.3.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts.

Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.5.3.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.5.3.3 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

2.6 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

2.7 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations.

PART 3 EXECUTION

3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a

label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
08/08

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

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 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The

organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

b. Section 26 12 19.00 40 PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.00 40

PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS
02/11

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.

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM D117	(2010) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D1535	(2012a) Specifying Color by the Munsell System
ASTM D3487	(2009) Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2012) Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012; Errata 2012; INT 1-4 2012) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage

	Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.34	(2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-90/027F	(1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

EPA 712-C-98-075 (1996) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"

UNDERWRITERS LABORATORIES (UL)

UL 467 (2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

1.4 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pad-Mounted Transformer Drawings; G;

SD-03 Product Data

Pad-Mounted Transformers; G;

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance Checks And Tests; G;

SD-07 Certificates

Transformer Losses; G

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer Design Tests; G;

Pad-mounted transformer Routine And Other Tests; G;

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G;

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Transformer Test Schedule; G;

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable

if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein.

2.2.1 Compartments

Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well insertsand feed-thru inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.

c. Load-break switch

(1) Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Conspicuously display warning within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

(1) Bayonet fuse assembly: 150 kV BIL.

(2) Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified. Connect current-limiting fuses ahead of the radial-feed load-break switch.

f. Surge arresters: IEEE C62.11, rated 15 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide three arresters for radial feed circuits. Provide six arresters for loop feed circuits.

g. Parking stands: Provide a parking stand near each bushing well.

Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

h. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

2.2.2 Compartment Construction

b. Two compartment: Separate the high- and low-voltage compartments with steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.3 Transformer

a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type, copper windings.

b. Transformer shall be rated 2000 kVA, 95 kV BIL.

c. Transformer voltage ratings: _12470____ V - _4160____ V. For GrdY - GrdY transformers, provide transformer with five-legged core design for third harmonic suppression.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than ___5.75__ percent at 85 degrees C on Three-Phase transformers .

f. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60
2000	61

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.3.1 Specified Transformer Losses

No-load losses (NLL) shall be __3,535___ watts at 20 degrees C and load losses (LL) shall be __21,750___ watts at 85 degrees C. Use the values for the specified losses for comparison with the losses determined during the routine tests. If the routine test values for no-load losses exceed the specified no-load losses by more than 10 percent, or the total losses exceed the specified total losses (sum of no-load and load losses) by more than 6 percent, the transformer is unacceptable.

2.2.4 Insulating Liquid

a. Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

b. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

(1) The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

(a) Pour point: ASTM D97, less than -15 degree C

(b) Aquatic biodegradation: EPA 712-C-98-075, 100%

(c) Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F, pass

2.2.4.1 Liquid-Filled Transformer Nameplates

Provide distribution transformers with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.5 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D1535.Entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure shall be fabricated of stainless steel conforming to ASTM A167, Type 304 or 304L. Form enclosure of stainless steel sheets. Paint entire

transformer assembly Munsell 7GY3.29/1.5 green. Paint coating system shall comply with IEEE C57.12.28. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.5 PADLOCKS

Provide padlocks for pad-mounted equipment and for each fence gate. Padlocks shall be keyed alike as directed by the Contracting Officer.

2.6 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE

Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 inch to 1 inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M. Air content shall

be between 4 and 6 percent.

2.7 SOURCE QUALITY CONTROL

2.7.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.7.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Perform design tests prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include the primary windings only of that transformer.

(1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.7.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

g. Leak

h. Dissolved gas analysis (DGA)

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 TRANSFORMER GROUNDING

Provide a 4/0 bare copper-ground girdle around transformer. Girdle shall be buried one foot deep and placed 3 feet laterally from the transformer enclosure. Connect girdle to enclosure at two opposite places using 4/0 copper. Exothermically weld joints.

3.4 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4.1 Meters and Current Transformers

ANSI C12.1.

3.5 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the

manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.6 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.7 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place the slab on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.7.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

3.7.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8 FIELD QUALITY CONTROL

3.8.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.8.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.

(7) Verify the presence of transformer surge arresters.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify that the tap-changer is set at specified ratio.

(3) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.8.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.8.1.3 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. Equip the instrument with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.8.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2010) Terminal Blocks
NEMA ICS 6	(1993; R 2006) Enclosures
NEMA MG 1	(2009) Motors and Generators

NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992; R 1997) Standard for Dry-Type Transformers for General Applications
NEMA TC 14	(2002) Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2007; Errata 2007) American National Standard for Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code
NFPA 70E	(2012) Standard for Electrical Safety in the Workplace
NFPA 780	(2011) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607	(2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

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

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2007) Standard for Flexible Metal Conduit
UL 1063	(2006) Machine-Tool Wires and Cables
UL 1660	(2004; Reprint Apr 2008) Liquid-Tight

	Flexible Nonmetallic Conduit
UL 360	(2009; Reprint Jun 2009) Liquid-Tight Flexible Steel Conduit
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2001; Reprint Apr 2010) Attachment Plugs and Receptacles
UL 506	(2008; Reprint Mar 2010) Specialty Transformers
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment
UL 514B	(2004; Reprint Nov 2009) Conduit, Tubing and Cable Fittings
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Reprint Mar 2010) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(2008) Thermoplastic-Insulated Wires and Cables
UL 943	(2006; Reprint May 2010) Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

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 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Transformers; G

Fire Pump Controllers G

Automatic Transfer Switch G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Marking strips drawings; G

SD-03 Product Data

Receptacles; G

Transformers; G

Motor controllers; G

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

Ground-fault receptacle test; G

SD-07 Certificates

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6 SEISMIC REQUIREMENTS

Seismic details shall conform to Section 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Plastic-Coated Rigid Steel

NEMA RN 1, Type 40(40 mils thick).

2.2.4 Flexible Metal Conduit

UL 1.

2.2.4.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.5 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.5.1 Fittings for Rigid Metal Conduit

Threaded-type. Split couplings unacceptable.

2.2.5.2 Fittings for EMT

Steel compression type.

2.2.6 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC and NEMA TC 14 for fiberglass, and UL 514B.

2.2.7 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.3.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and capacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.3.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.3.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.3.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

d. On three-phase, four-wire delta system, high leg shall be orange, as required by NFPA 70.

2.3.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN 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 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.

2.3.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.4 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of brown as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.4.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.4.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.4.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.5 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs); shall conform to UL 508 and UL 489 and shall be provided as shown. MSCPs shall consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. MSCPs shall be rated in accordance with the requirements of NFPA 70.

2.6 TRANSFORMERS

NEMA ST 20, general purpose, oil-type, self-cooled, ventilated. Provide transformers in 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

2.7 MOTORS

NEMA MG 1 except fire pump motors shall be as specified in Section 21 30 00 FIRE PUMPS; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 1 HP and above shall be continuous duty type.

Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.7.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.7.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.8 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2, except fire pump controllers shall be as specified in Section 21 30 00 FIRE PUMPS. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be rms symmetrical amperes..

2.8.1 Control Wiring

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and

terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.8.2 Control Circuit Terminal Blocks

NEMA ICS 4. Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.8.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.8.3 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including transformers connected to __other normal source___. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.8.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.8.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.9 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

2.10 GROUNDING AND BONDING EQUIPMENT

2.10.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.11 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.12 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.13 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.14 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which

shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Dark Gray. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.15 SOURCE QUALITY CONTROL

2.15.1 Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Hazardous Locations

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one

enclosure, shall be provided only as permitted by NFPA 70.

3.1.4 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped. .

3.1.4.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.5 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits under floor slab as if exposed.

3.1.5.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.2 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms,

electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

b. Electrical Nonmetallic Tubing

(1) Do not install underground.

(2) Do not encase in concrete except when provided with fittings identified for this purpose are used for connections.

(3) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(4) Do not use in hazardous areas.

(5) Do not use outdoors.

(6) Do not use in sizes larger than 2 inch.

(7) Do not run exposed in buildings exceeding three floors above grade, where "first floor" is as defined in NFPA 70.

(8) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.5.5 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.5.6 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.5.7 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of __12___ inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.5.8 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.5.9 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway shall be converted to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.5.10 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.5.11 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system

into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.5.12 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.5.13 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.5.14 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible nonmetallic conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.6 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. 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 sheathed cable conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets

for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.6.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 4 11/16 inches square by 2 1/8 inches deep. Mount outlet boxes flush in finished walls.

3.1.6.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.7 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet.

3.1.8 Nonmetallic Sheathed Cable Installation

Where possible, install cables concealed behind ceiling or wall finish. Thread cables through holes bored on approximate centerline of wood members; notching of end surfaces is not permitted. Provide sleeves

through concrete or masonry for threading cables. Install exposed cables parallel to or at right angles to walls or structural members. Protect exposed nonmetallic sheathed cables less than 4 feet above floors from mechanical injury by installation in conduit or tubing. When cable is used in metal stud construction, insert plastic stud grommets in studs at each point through which cable passes, prior to installation of cable.

3.1.9 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

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 33 inches maximum intervals. Make cable terminations in accordance with NFPA 70 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

3.1.10 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.10.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.11 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.11.1 Splices of Aluminum Conductors

Make with solderless circumferential compression-type, aluminum-bodied connectors UL listed for AL/CU. Remove surface oxides from aluminum conductors by wire brushing and immediately apply oxide-inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound, and insulate splice.

3.1.12 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.13 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings. .

3.1.14 Grounding and Bonding

Provide In accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, access flooring support system, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA J-STD-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.14.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance of a driven ground shall not exceed 5 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 5 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.14.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.14.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, ground buses shall be provided and connected to the building grounding system. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.14.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.15 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.16 Government-Furnished Equipment

Contractor shall rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.17 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.17.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit,

raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.17.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.17.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.17.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each tests.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 28 21.00 40

AUTOMATIC TRANSFER SWITCHES
08/11

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

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 AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	(2012) Transfer Switch Equipment
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection Diagrams; G

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

Contacts; G

Indicating Lights; G

Terminal Board; G

Enclosures; G

SD-06 Test Reports

Qualification Testing; G

Operation Tests; G

SD-07 Certificates

Listing of Product Installations; G

SD-08 Manufacturer's Instructions

Automatic Transfer Switch; G

1.3 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.4 QUALIFICATION TESTING

Provide certified independent laboratory test data for the furnished unit or an identical unit. Ensure tests meet the general use requirements of UL 508, Table 22.1. Subject the complete automatic transfer switch to a test as outlined in NEMA ICS 1, paragraph 109.5. One cycle of operation tests under the UL 508 test requirements consists of a transfer of load from source 1 to source 2 and retransfer to the source 1. After the required number of test cycles, ensure the temperature rise of the contacts has not exceeded 149 degrees F. Test the switch operating time and the sense relay pickup and dropout times.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete medium-voltage automatic transfer switch system for use with source to source for non-emergency power. Submit the following:

a. Connection diagrams showing the relations and connections of contacts, indicating lights, and terminal board by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another.

b. Fabrication drawings for contacts, indicating lights, terminal board enclosures, and accessories consisting of fabrication and assembly details to be performed in the factory.

c. Installation drawings for automatic transfer equipment in accordance with the paragraph entitled, "Installation," of this section.

d. Equipment and performance data for automatic transfer equipment including life, test, system functional flows, safety features, and mechanical automated details.

2.1.1 Design Requirements

Ensure control and protective devices associated with automatic transfer switches are in accordance with Section 26 05 70.00 40 HIGH VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

Provide an automatic transfer switch of the three-pole type for three-phase application.

2.1.2 Performance Requirements

Provide an automatic transfer switch capable of transferring the load from power source 1 to power source 2, and from an source 2 to source 1. Locate switch where indicated. Provide a switch that is solenoid-operated, mechanically held, double-throw, rated for continuous duty, capable of transferring in 100 milliseconds or less, and conforming to the applicable requirements of UL 1008 and NFPA 70, Article 700, except as herein modified.

Ensure the automatic transfer switch is capable of being placed in either the source 1 or source 2 positions.

2.2 FABRICATION

2.2.1 Short Circuit Withstand Current Rating

Provide switch with short-circuit current rating of 22K.

2.2.2 Self-Test Capability

Provide an automatic transfer switch with a control-circuit self-test feature capable of verifying the proper operation of the switch control circuit without moving the main contactor or causing discontinuity of service to the load. Include the following characteristics in the self-test circuit:

a. A key-operated switch that disconnects the main actuator and connects in its place, an indicator light. Design the key-operated switch to prevent removal of the key while the switch is in the self-test mode.

b. A power-failure simulator switch that removes voltage from the voltage-sensing devices so that power source 2 activates the test light.

2.2.3 Enclosures

Provide automatic transfer switch enclosures with solid, unventilated, code-gage 14-gage, minimum sheet metal, NEMA 250, Type 1, with manufacturer's standard finish.

2.3 COMPONENTS

2.3.1 Contacts

Provide main and secondary contacts with silver-plated copper.

2.3.2 Indicating Lights

Furnish automatic transfer switch with two indicating lamps. One light to indicate that the switch is operating on source 1 power, and the other light to indicate that the switch is operating on source 2 power. Fuse each indicating circuit.

2.3.3 Terminal Board

Internally wire control devices, indicating lights, auxiliary contacts, and internal control devices or auxiliary switches to a common output terminal board. Wire the internal functions to facilitate remote connections or monitoring.

2.4 OPERATION

Monitor source 1 voltage across phase lines by sensing devices. If the source 1 voltage in phase drops to 90 percent or less for a timed period, the automatic transfer switch transfer the load to source 2. . Field adjust this time period from 1 to 30 seconds. Provide a voltage and frequency sensor relay to monitor rated values on the source 1 side to prohibit transfer until source 2 voltage and frequency reach at least 95 percent of the required rating. Provide phase failure protection, with 65 to 70 percent drop and 92 to 95 percent voltage pickup ratings.

Furnish the automatic transfer switch with a time-delay feature, field adjustable from 2 to 30 minutes, that operates to delay automatic transfer back to source 1 power untilsource 1 voltage and frequency reach at least 95 percent of the rated voltage. However, if source 2 fails, and source 1 is again available at 90 percent of the rated voltage, bypass the time-delay circuitry, and the load immediately transferred back to the source 1. Provide capability for manual transfer in either direction. Operate sensing relays without contact chatter or false response during voltage variations between dropout and pickup.

PART 3 EXECUTION

3.1 INSTALLATION

Install automatic transfer switch as indicated, and in accordance with the

manufacturer's installation instructions. Fully align and install wall-mounted enclosures at the indicated mounting height using a minimum of six 3/8-inch bolts. Use of sheet metal screws or small machine screws is not permitted.

Submit listing of product installations for automatic transfer switches showing the manufacturer has successfully manufactured automatic transfer switches of the size specified for a minimum period of 10 years. Include on the list, purchaser, address of installation, service organization, and date of installation.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate the automatic transfer switch operates in accordance with the specification requirements in conjunction with the source 1 and source 2 power sources.

-- End of Section --

SECTION 28 31 64.00 10

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
08/09

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.41	(1990; R 2008) Audible Emergency Evacuation Signal (ASA 96)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 72	(2013) National Fire Alarm and Signaling Code
NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired
UL 38	(2008; Reprint Dec 2008) Manual Signaling Boxes for Fire Alarm Systems
UL 464	(2009; Reprint Apr 2012) Standard for Audible Signal Appliances
UL 521	(1999; Reprint May 2010) Heat Detectors for Fire Protective Signaling Systems

UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 864	(2003; Reprint Aug 2012) Standard for Control Units and Accessories for Fire Alarm Systems

1.2 SYSTEM DESCRIPTION

The fire detection and alarm system and the central reporting system shall be a complete, supervised fire alarm reporting system configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. Furnish equipment compatible and UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards. Locks shall be keyed alike. Provide four keys for the system. Furnish tags with stamped identification number for keys and locks.

1.2.1 Operation

Activate the system into the alarm mode by actuation of any alarm initiating device. The system will remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm and supervisory initiating devices shall be individually addressable. Alarm initiating devices shall be connected to initiating device circuits (IDC) and to signal line circuits (SLC) in accordance with NFPA 72. Connect alarm notification appliances to notification appliance circuits (NAC). Maintain existing Class of wiring used throughout each hangar in accordance with NFPA 72. 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. Size each SLC to provide 40 percent addressable expansion without hardware modifications to the panel.

1.2.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC, SLC, and NAC.

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. Submit Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation. 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. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD displays on the control panel 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.

f. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

g. 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.

h. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

i. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

j. The fire alarm control panel shall monitor and control the fire sprinkler system, or other fire protection extinguishing system.

k. 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.

l. Zones for IDC and NAC shall be arranged as indicated on the contract drawings .

1.2.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of signals over the existing fire alarm network. The signal shall be common for any device .

b. Visual indications of the alarmed devices on the fire alarm control panel display .

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ASA S3.41.

d. Deactivation of the air handling units throughout the building.

e. Automatic discharge of the designated fire suppression systems upon activation of two automatic detectors or one manual release station within the protected area. A 15 second maximum delay shall be provided for the single interlock preaction system. A 30 second delay shall be provided for the double interlock foam suppression system.

1.2.4 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.

1.2.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.2.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. Submit 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. The new equipment shall be connected to an existing control panel in the existing part of the building (Building 4840 only) . Existing control equipment shall be expanded, modified, or supplemented as necessary to extend the existing control functions to the new points or zones. 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.

1.2.7 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.

1.3 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Storage Batteries
Low Battery Voltage
Special Tools and Spare Parts
Technical Data and Computer Software; G
Training
Testing

SD-06 Test Reports

Testing

SD-07 Certificates

Equipment
Qualifications

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Submit proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

1.4.1.1 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.

1.4.1.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 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.

1.4.1.3 Fire Protection Engineer

Installations needing designs or modifications of fire detection, fire alarm, or fire suppression systems 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.

1.4.2 Detail Drawings

Submit detail drawings 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 audible appliances. Check the layout based on the actual audible devices 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. Detail drawings and detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 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.

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:

a. Identification of programmable portions of system equipment and capabilities.

b. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

c. Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

d. Description of Fire Alarm Control Panel equipment operation.

e. Description of auxiliary and remote equipment operations.

f. Library of application software.

g. Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

1.7 SPECIAL TOOLS AND SPARE PARTS

Submit 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. Furnish software, connecting cables, proprietary equipment and two spare fuses of each type and size required, necessary for the maintenance, testing, and reprogramming of the equipment. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Mount spare fuses in the fire alarm panel.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide material and equipment which are 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.

2.2 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a

noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

2.3 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Provide a Simplex 4100ES fire alarm control panel or equivalent. Control panel shall be a 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. Control panel shall be capable of monitoring and operating multiple preaction systems and foam suppression systems as outlined on the drawings and sequence of operations. Provide equipment and connections required to perform these functions for each hangar.

a. 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.

b. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

c. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red .

2.3.1 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.

2.3.2 Circuit Connections

Connect circuit conductors entering or leaving the panel to screw-type terminals with each conductor and terminal marked for identification.

2.3.3 System Expansion and Modification Capabilities

Provide, as part of this contract, any equipment and software needed by qualified technicians to implement future changes to the fire alarm system.

2.3.4 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 Class B 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.

2.3.5 Addressable Initiating Device Circuits Module

Configure the initiating device being monitored to match existing circuit Class . The system shall 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.

2.4 STORAGE BATTERIES

Submit 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. Provide storage batteries which are 24 Vdc sealed, lead-calcium type requiring no additional water with 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. Locate batteries at the bottom of the panel . Provide batteries with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Paint the cabinets to match the fire alarm control panel.

2.5 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. Locate charger in control panel cabinet or in a separate battery cabinet.

2.6 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 surface mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double 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 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 .

2.7 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A 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.

2.7.1 Heat Detectors

Design heat detectors for detection of fire by fixed temperature or rate compensating principle to match existing . 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 and as shown on drawings, 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.

2.7.1.1 Rate Compensating Detectors

Detectors shall be surface or flush mounted 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.

2.7.1.2 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 to match that of the existing system(s). The UL 521 test rating for the fixed temperature detectors shall be rated for 15 by 15 ft.

2.7.2 BID OPTION: Cross Zoned Linear thermistor Heat Detector

BID OPTION: Cross zoned linear thermistor (line-type electrical conductivity) fire detector having a temperature setting of 170 degree F. Maximum spacing between detection lines is 30 feet nominally. The manufacturer must verify the detector response setting by an approved test method after installation. On steeply sloped or curved roofs, thermistor detectors must be installed perpendicular to the slope or arc (along the axis of the curve).

The area covered by the fire detection system must correspond with its affiliated roof-level preaction sprinkler system bound by draft curtains. The sequence of operation shall match that of the spot type heat detection.

Install all vertical conductors in conduit. Linear heat detection shall be installed at ceiling/roof level per manfucturer and code requirements. In areas with ceilings install linear heat detection below ceiling. In areas exposed to structure install linear heat detection tight to underside of roof decking. Secure linear heat detection compenents in accordance with manufacturer recommended methods.

2.7.3 Smoke Detectors

Design smoke detectors for detection of abnormal smoke densities. Smoke detectors shall be photoelectric 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.2.7.3.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.8 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 .

2.8.1 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.

2.8.2 Beacon Lights

Beacon lights shall conform to the applicable requirements of UL 1638 and the contract drawings. Appliances shall have blue high intensity optic lense, xenon strobe, 24 VDC. Beacon lights shall have appropriate signage to notify personnel that activation indicates foam discharge.

2.8.3 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 15 candela. Strobe shall be surface mounted.

2.8.4 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.

2.9 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.9.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.9.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be 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.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Install all work as shown, 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.

3.2.1 Power Supply for the System

Provide a single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system. 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".

3.2.2 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.

3.2.3 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.

3.2.4 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. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location .

3.2.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.2.6 Beacon Lights

Mount blue beacon lights in same location as existing red beacon lights where applicable. Where red beacon lights do not presently exist, mount blue beacon lights in upright position between 12 ft and 14 ft above finished floor.

3.2.7 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.2.8 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 specified in Section 21 13 18.00 10 PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION, as indicated on the drawings and as specified herein.

3.2.9 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 specified in Section 21 13 18.00 10 PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION, as indicated on the drawings and as specified herein.

3.3 OVERVOLTAGE AND SURGE PROTECTION

3.3.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 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).

3.3.2 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 in accordance with IEEE C62.41.1/IEEE C62.41.2 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).

3.3.3 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 in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.4 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.5 SUPERVISING STATION PROVISIONS

3.5.1 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.

3.6 TRAINING

Submit 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. Conduct the course in the building where the system is installed or as designated by the Contracting Officer.

a. 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 days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

b. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. Provide training course for the maintenance staff. 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. 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.

c. The training period for systems operation shall consist of 1 training days (8 hours per day per building) and shall start after the system is functionally completed but prior to final acceptance tests. 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.

3.7 TESTING

Notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. Perform the tests 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. Furnish instruments and personnel required for the tests.

a. Submit detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

b. Submit 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. Include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

3.7.1 Preliminary Tests

Upon completion of the installation, subject the system 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. Conduct the megger test 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 complete and submit the NFPA 72, Certificate of Completion and Testing Form.

3.7.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Conduct testing in accordance with NFPA 72. The recommended tests in NFPA 72 are considered mandatory and shall verify that previous deficiencies have been corrected. The Fire alarm Technician supervising the installation of the fire alarm system shall attend the testing of the system. 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.

-- End of Section --

SECTION 31 00 00

EARTHWORK
04/12

PART 1 GENERAL

1.1 MEASUREMENT PROCEDURES

1.1.1 Excavation

The unit of measurement for excavation will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

1.1.2 Piping Trench Excavation

Measure trench excavation by the number of linear feet along the centerline of the trench and excavate to the depths and widths specified for the particular size of pipe. Replace unstable trench bottoms with a selected granular material. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.

1.1.3 Overhaul Requirements

Allow the unit of measurement for overhaul to be the station-yard. The overhaul distance will be the distance in stations between the center of volume of the overhaul material in its original position and the center of volume after placing, minus the free-haul distance in stations. The haul distance will be measured along the shortest route determined by the Contracting Officer as feasible and satisfactory.

1.2 PAYMENT PROCEDURES

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.2.1 Classified Excavation

Classified excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.

1.2.2 Piping Trench Excavation

Payment for trench excavation will constitute full payment for excavation and backfilling, including specified overdepth except in rock or unstable trench bottoms.

1.2.3 Unclassified Excavation

Unclassified excavation will be paid for at the contract unit price per cubic yard for unclassified excavation.

1.2.4 Authorized Overhaul

The number of station-yards of overhaul to be paid for will be the product of number of cubic yards of overhaul material measured in the original position, multiplied by the overhaul distance measured in stations of 100 feet and will be paid for at the contract unit price per station-yard for overhaul in excess of the free-haul limit as designated in paragraph DEFINITIONS.

1.3 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

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

c. Hard materials will not be encountered in 95 percent of the excavations .

1.4 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 T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 33/C 33M	(2011) Standard Specification for Concrete Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2937	(2010) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.5 DEFINITIONS

1.5.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML, CH, MH. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.5.2 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. Notify the Contracting Officer when

encountering any contaminated materials.

1.5.3 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. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.5.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.5.5 Overhaul

1.5.6 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 1 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 1 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.6 SYSTEM DESCRIPTION

1.6.1 Classification of Excavation

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

1.6.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.7 SUBMITTALS

SD-03 Product Data

Utilization of Excavated Materials; G

Shoulder Construction

SD-06 Test Reports

Testing
Borrow Site Testing

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Within 24 hours of conclusion of physical tests, submit 5 copies of test results, including calibration curves and results of calibration tests. Do not bring material onsite until tests have been approved by the Contracting Officer.

PART 3 EXECUTION

3.1 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from other approved areas selected by the Contractor as specified.

3.1.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on

construction documents. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.1.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.1.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.1.4 Trench Excavation Requirements

3.1.4.1 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.1.5 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2 OPENING AND DRAINAGE OF EXCAVATION

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, excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Ensure that excavation of any area, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.3 SHORING

3.3.1 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.4 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.5 GROUND SURFACE PREPARATION

3.5.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.6 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. . Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material 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.

3.7 BURIED TAPE AND DETECTION WIRE

3.7.1 Buried Warning and Identification Tape

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

3.7.2 Buried Detection Wire

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

3.8 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 95 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. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.8.1 Trench Backfill

3.8.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.9 SPECIAL REQUIREMENTS

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

3.9.1 Sewage Absorption Trenches or Pits

3.9.1.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation conforming to the requirements of gradation No. 4 for coarse aggregate in ASTM C 33/C 33M.

3.10 SUBGRADE PREPARATION3.10.1 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, do not show deviations for the surface of the subgrade for airfields greater than 1/4" inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.10.2 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.10.2.1 Subgrade for Pavements

Compact subgrade for pavements 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, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.10.2.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the depth below the surface of shoulder shown .

3.10.2.3 Subgrade for Airfield Pavements

Compact top 24 inches below finished pavement or top 12 inches of subgrades, whichever is greater, to 95percent of ASTM D 1557; compact fill and backfill material to 95 percent of ASTM D 1557.

3.11 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated material or as otherwise shown or specified.. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area 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. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction 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. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.12 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.12.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base,

surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.12.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.13 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D 1556 . ASTM D 2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.13.1 Fill and Backfill Material Gradation

One test per 100 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136 .

3.13.2 In-Place Densities

3.13.3 Check Tests on In-Place Densities

If ASTM D 6938 is used, check in-place densities by ASTM D 1556 as follows:

c. One check test per lift for each 100 linear feet, or fraction thereof, of embankment or backfill for airfields.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two

tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.13.5 Optimum Moisture and Laboratory Maximum Density

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

3.13.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.14 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as removed from Government property as directed by the Contracting Officer.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
04/12

PART 1 GENERAL

The following information must be shown on the project drawings:
1. Limits of clearing.
2. Limits of grubbing.
3. Trees and shrubs to remain in area to be cleared.
4. Trees to be removed in areas which are not to be cleared.
5. Describe size, density, and type of trees to be celared and grubbed.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

NOT USED

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

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.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 30 00.

3.2 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 downed timber, snags, brush, and rubbish occurring within the areas to be cleared. 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.

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 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 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. 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.

3.6 DISPOSAL OF MATERIALS

3.6.1 Nonsaleable Materials

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

-- End of Section --

SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

04/12

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

1.1.1 Standard and Geosynthetic Binder

Measure the standard and geosynthetic binder by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the binder.

1.1.2 Mulch and Compost

Measure mulch and compost by the square yard of surface area covered. No measurement for payment will be made for binder, dye or other miscellaneous materials or equipment necessary for placement of the mulch or compost.

1.1.3 Hydraulic Mulch

Measure hydraulic mulch by the square yard of surface area covered. Measurement for payment will include binder, dye or both. No measurement for payment will be made for other miscellaneous materials or equipment necessary for placement of the hydraulic mulch.

1.1.4 Geotextile Fabric

Measure geotextile fabrics by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the fabric.

1.1.5 Erosion Control Blankets

Measure erosion control blankets by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching or other miscellaneous materials necessary for placement of the erosion control blankets.

1.1.6 Synthetic Grid/Sheet Systems

Measure synthetic grid/sheet system by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

1.1.7 Cellular Concrete Block Systems

Measure articulating cellular concrete block system by the square yard of surface area covered. No measurement for payment will be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating

cellular concrete block system.

1.2 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.

ASTM INTERNATIONAL (ASTM)

ASTM D 1777	(1996; R 2007) Thickness of Textile Materials
ASTM D 3776/D 3776M	(2009a; R 2011) Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2007) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(2009) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004; R 2009) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(2001; R 2007) pH of Soils
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 5035	(2011) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(2007) Topsoil Used for Landscaping Purposes

1.3 SYSTEM DESCRIPTION

The work consists 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 includes all necessary materials, labor, supervision and equipment for installation of a complete system. Submit a listing of equipment to be used for the application of erosion control materials. Coordinate this section with the requirements of Section 31 00 00 EARTHWORK. Complete backfilling the openings in synthetic grid systems and articulating cellular concrete block systems a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Geosynthetic Binders; Recycled Plastic
Wood Cellulose Fiber
Paper Fiber
Mulch Control Netting and Filter Fabric
Hydraulic Mulch;
Erosion Control Blankets Type XI
Geotextile Fabrics;
Aggregate
Synthetic Grid Systems;
Articulating Cellular Concrete Block Systems;
Equipment
Finished Grade
Erosion Control Blankets

SD-04 Samples

Materials

SD-06 Test Reports

Geosynthetic Binders
Hydraulic Mulch
Geotextile Fabrics
Erosion Control Blankets
Synthetic Grid Systems
Articulating Cellular Concrete Block Systems

1.5 QUALITY ASSURANCE

1.5.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

1.5.2 Substitutions

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls to provide identification sufficient for inventory and quality control purposes.

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 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. Content shall be a minimum of 75 percent recycled materials. Sewn seams shall have strength equal to or greater than the geotextile itself. Install fabric 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/D 3776M
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 EROSION CONTROL BLANKETS

2.2.1 Erosion Control Blankets Type I

Use Type I blankets 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. Cover the blanket 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 0.50 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.

2.2.2 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. Cover the blanket 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. Sew the blanket 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 0.50 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 gradient.

2.2.3 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. Cover the blanket 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 by 1/2 inch mesh. Sew the blanket 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 0.35 lb/yd^2.
Coconut Fiber	30 percent by approximately 0.15 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.

2.2.4 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. Cover the blanket on the top and bottom sides with lightweight photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh. Sew the blanket 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 0.5 lb/yd^2 weight.
Netting	Both sides lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

Material Content

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.

2.2.5 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. Cover the blanket 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. Cover the bottom with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photo accelerators. Sew the blanket 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 0.5 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.

2.2.6 Erosion Control Blankets Type VI

Erosion control blanket shall be a machine-produced 100 percent 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. Cover the blanket 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. Sew the blanket 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 0.50 lb/yd^2 weight
Netting	One side only, Leno woven 100% biodegradable natural organic fiber

Material Content

Weight	approximately 9.3 lb/1,000 ft.
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.

2.2.7 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. Cover the blanket 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. Sew the blanket 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 0.5 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.

2.2.8 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. Cover the blanket 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. Sew the blanket 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 . 0.35 lb/yd^2 weight. 30 percent coconut fiber cured in fresh water with approximately

0.15 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.

2.2.9 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/D 3776M	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 5034	177	lbs
Elongation	ASTM D 5034	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 5034 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.

PART 3 EXECUTION

3.1 WEATHER CONDITIONS

3.1.1 Finished Grade

Provide condition of finish grade status prior to installation, location of underground utilities and facilities. Verify that finished grades are as indicated on the drawings; complete finish grading and compaction in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the work. Verify and mark the location of underground utilities and facilities in the area of the work. Repair damage to underground utilities and facilities 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 will not be permitted directly on the blankets.

3.2 SITE PREPARATION

3.2.1 Soil Test

Test soil 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. Submit scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

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. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high-visibility fencing along the dripline. Mitigate damage to existing trees 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 CLEAN-UP

Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.4 MAINTENANCE RECORD

Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.4.1 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.

3.4.2 Maintenance Instructions

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

3.4.3 Patching and Replacement

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

-- End of Section --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES
08/10

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.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2011) Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM C94/C94M	(2012a) Standard Specification for Ready-Mixed Concrete
ASTM F1043	(2012) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F1083	(2010) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F567	(2011a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2008) Standard Specification for Fence Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191/3	(Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G

Location of Gate, Corner, End, and Pull Posts; G

Gate Assembly; G

Gate Hardware and Accessories; G

Erection/Installation Drawings; G

SD-03 Product Data

Fence Assembly; G

Gate Assembly; G

Gate Hardware and Accessories; G

Zinc Coating; G

Aluminum Alloy Coating; G

Stretcher Bars; G

SD-04 Samples

SD-07 Certificates

Certificates of Compliance; G

SD-08 Manufacturer's Instructions

Fence Assembly; G

Gate Assembly; G
Hardware Assembly; G

Accessories; G

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating, and chemical composition and thickness of aluminum alloy coating.

1.5.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating

b. PVC coating

c. Aluminum alloy coating

d. Fabric

e. Stretcher bars

f. Gate hardware and accessories

g. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F1083 .

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F1043

d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 FABRIC

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, ASTM A702 and ASTM F626, with 2.0 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and provide twisted and barbed top selvage and knuckled bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

2.5 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.6 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.7 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and

prevent intrusion of concrete.

2.8 TOP RAIL

Provide Grade A weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.9 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade A weighing 2.27 pounds per linear foot.

2.10 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.11 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 2.0 ounces per square foot.

2.12 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F626.

2.13 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.14 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.15 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

2.16 GATES

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is spot welded or by peening to provide rigid connections. Install fabric with stretcher bars at vertical edges;

stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with spot welds or by peening or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.17 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F626, Federal Specification RR-F-191K/GEN and be as specified:

Provide forged steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.18 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.19 WIRE TIES

Provide 9-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 12 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 12 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

2.20 CONCRETE

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.21 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.22 PADLOCKS

PART 3 EXECUTION

Provide complete installation conforming to ASTM F567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or on areas of Government property, as directed.

When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated . Compact concrete to eliminate voids, and finish to a dome shape.

3.3.2

3.3.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of

fence, and a diagonal tension rod.

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.7 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.8 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 9-gage ties or clips spaced 12 inches on center.

3.9 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.10 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 12 inches on center.

3.11 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as

recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.12 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.13 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.16 SITE PREPARATION

3.16.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.17 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating.

3.17.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.17.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.18 ACCESSORIES INSTALLATION

3.18.1 Post Caps

Install post caps as recommended by the manufacturer.

3.18.2

3.19 GROUNDING

Ground fencing as indicated on drawingsand specified.

Ground fences 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 can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 6 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms

3.20 SECURITY

3.21 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
06/13

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

1.1.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes. Pipe will be paid for at the contract unit price for the number of linear feet of culverts or storm drains placed in the accepted work.

1.1.2 Storm Drainage Structures

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth of 2 feet in the accepted work. The depth of manholes and inlets will be measured from the top of grating or cover to invert of outlet pipe. Manholes and inlets constructed to depths greater than the depth specified above will be paid for as units at the contract unit price for manholes and inlets, plus an additional amount per linear foot for the measured depth beyond a depth of 3 feet.

1.1.3 Walls and Headwalls

Walls and headwalls will be measured by the number of cubic yards of reinforced concrete, plain concrete, or masonry used in the construction of the walls and headwalls. Wall and headwalls will be paid for at the contract unit price for the number of walls and headwalls constructed in the completed work.

1.1.4 Flared End Sections

Flared end sections will be measured by the unit. Flared end sections will be paid for at the contract unit price for the various sizes in the accepted work.

1.1.5 Sheeting and Bracing

Payment will be made for that sheeting and bracing ordered to be left in place, based on the number of square feet of sheeting and bracing remaining below the surface of the ground.

1.1.6 Rock Excavation

Payment will be made for the number of cubic yards of material acceptably excavated, as specified and defined as rock excavation in Section 31 00 00 EARTHWORK, measured in the original position, and computed by allowing actual width of rock excavation with the following limitations: maximum rock excavation width, 30 inches for pipe of 12 inch or less nominal diameter; maximum rock excavation width, 16 inches greater than outside diameter of pipe of more than 12 inch nominal diameter. Measurement will

include authorized overdepth excavation. Payment will also include all necessary drilling and blasting, and all incidentals necessary for satisfactory excavation and disposal of authorized rock excavation. No separate payment will be made for backfill material required to replace rock excavation; this cost shall be included in the Contractor's unit price bid per cubic yard for rock excavation. In rock excavation for manholes and other appurtenances, 1 foot will be allowed outside the wall lines of the structures.

1.1.7 Backfill Replacing Unstable Material

Payment will be made for the number of cubic yards of select granular material required to replace unstable material for foundations under pipes or drainage structures, which will constitute full compensation for this backfill material, including removal and disposal of unstable material and all excavating, hauling, placing, compacting, and all incidentals necessary to complete the construction of the foundation satisfactorily.

1.1.8 Pipe Placed by Jacking

Payment will be made for the number of linear feet of jacked pipe accepted in the completed work measured along the centerline of the pipe in place.

1.2 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 M 198	(2010) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M 294	(2010) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

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

AREMA Eng Man	(2010) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A716	(2008) Standard Specification for Ductile

	Iron Culvert Pipe
ASTM A74	(2009) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A929/A929M	(2001; R 2007) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	(2009) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C 1103	(2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 139	(2010) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 14	(2007) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 1433	(2010) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 270	(2010) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(2009) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 425	(2004; R 2009) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2010) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 444	(2003; R 2009) Perforated Concrete Pipe
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 506	(2011) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	(2011) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 55	(2009) Concrete Brick
ASTM C 564	(2009a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

ASTM C 62	(2010) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 655	(2011) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 76	(2011) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2729	(2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2010a) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F 1417	(2011) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F 477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(2008) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(2010) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(2003; R 2010) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(2007) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

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

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

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

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C 76, Class V, or ASTM C 655, 3,000 D-Load.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C 506, Class A-IV.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C 507. Horizontal elliptical pipe shall be Class HE-IV. Vertical elliptical pipe shall be

Class VE-V .

2.1.2 Ductile Iron Culvert Pipe

ASTM A716.

2.1.3 Cast-Iron Soil Piping

Cast-Iron Soil Pipe shall conform to ASTM A74, service-weight; gaskets shall be compression-type rubber conforming to ASTM C 564.

2.1.4 Perforated Piping

2.1.4.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C 444, and applicable requirements of ASTM C 14, Class V.

2.1.4.2 PVC Pipe

ASTM D 2729.

2.1.5 PVC Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.5.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.5.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.5.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.5.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.6 PE Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.6.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.6.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.6.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
Nominal Size (in.)	Minimum Wall Area (square in/ft)	Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.1.6.4 Series 54 Metal Seated Gate Valve

Gate valves shall be of the double-flanged, non-rising, solid wedge gate type designed in general accordance with AWWA C500 ANSI and ASTM and other industry standards.

Valve Body
The body, bonnet and glands shall be manufactured from ductile iron ASTM 536. The body and wedge rings are mechanically fastened in position. Body and wedge rings shall be manufactured from ASTM 536 or Aluminum Bronze C95200 ASTM B30 or ASTM B148. The faces will be machined to a smooth surface finish to ensure suitable sealing performance. Flange drilling according to ANSI B16.1 Class 125 (For 66", to AWWA C507-01 Class E). Face ring Bronze ASTM B62 C83600 150 psi, 250 psi and 300 psi valves available.

Wedge Nut
The wedge nut will be manufactured from Bronze ASTM B148 C95500 or Aluminum Bronze C95200 ASTM B30 or ASTM B148 and will be properly fitted to the recess at the top of the wedge.

Stem
The stem will be accurately machined and highly finished and manufactured from Stainless steel ASTM A276-431. Stem shall be capable of twice the yield strength required by AWWA C500.

Stem Seal
The stem seal will be by means of conventional stuffing box / gland packing with ample
depth to ensure long life to the PTFE gland packing material. The conventional direction of operation is clockwise to close but clockwise to open is also available. This must be specified prior to bid date.

Wedge Guides
The guides in the wedge shall ensure uniform closure regardless of high pressures.
The wedge has a large through bore housing in the stem that ensures no stagnant water or impurities can collect.

Operating Requirements
The maximum operating input effort shall be 4425 in lbs. 2213 in. lbs. push pull. (500 Nm 250 Nm push / pull). Depending on the differential pressure and valve size, the valve may require to be fitted with a suitable gearbox to ensure the maximum input effort is achieved. Where a gearbox is required, the valve will have a suitable ANSI mounting flange. All valves 28 in. and above require a gearbox and/ or electrical actuator to be fitted.

Valve Testing
Prior to shipment from the original manufacturing location each valve shall be hydrostatically tested in accordance with AWWA C500. The body shall be tested to 1.5 times valve pressure rating and both seats shall be tested to 1.1 times valve pressure rating. The maximum allowable leakage rate will be 'Rate B'.

Fasteners
Stainless steel fasteners shall be standard.

Lifting Rings
Suitable lifting rings shall be supplied as standard.

Valve Coatings
The valves shall be coated internally and externally with epoxy coating to a minimum dry film thickness of two part epoxy coating (250 microns). All internal coatings shall be NSF compliant.

Valve Experience
Valve manufacturers shall have a minimum of 20 years of successful manufacture and installation of Metal Seated Gate Valves.
Text

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 A929/A929M.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C 1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4500 psi concrete under Section . The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 2.13 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

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

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

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 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

2.3.7 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

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

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.8.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 B3 , and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.8.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.8.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.8.6 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477.

2.3.8.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.8.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage

structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A48/A48M, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

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

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, Clay, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

2.8 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 10 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 20 inches.

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 31 00 00 EARTHWORK 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 24 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, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing 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 granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Ductile Iron and Cast-Iron Pipe

Bedding for ductile iron and cast-iron pipe shall be as shown on the drawings.

3.2.3 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

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

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

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Ductile Iron Culvert	3
Plastic (PVC & HDPE)	5

Note post installation requirements of paragraph 'Deflection Testing' in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

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

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.5 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

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

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side

of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

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

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

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

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

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

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

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible 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 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

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 is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 6938. When ASTM D 6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 6938 results in a wet unit weight of soil and ASTM D 6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 6938. 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

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 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.

3.8.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.

b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum Alloy, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.

c. Deflection measuring device: Shall be approved by the Contracting Officer prior to use.

d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph PLACING PIPE above, just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all

pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.8.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP) shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and finial post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/08

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.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	(2007) specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B3	(2012) Standard Specification for Soft or Annealed Copper Wire
ASTM B496	(2013) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B800	(2005; R 2011) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
ASTM B801	(2007; R 2012) Standard Specification for

	Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
ASTM C478	(2013) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2013) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D4059	(2000; R 2010) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D923	(2007) Standard Practice for Sampling Electrical Insulating Liquids

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5 2013) National Electrical Safety Code
IEEE C37.121	(2012) American National Standard for Switchgear-Unit Substations - Requirements
IEEE C37.20.1	(2002; INT 1 2005; AMD A 2005; AMD B 2006;

	R 2007) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1999; Corr 2000; R 2005) Standard for Metal-Clad Switchgear
IEEE C37.20.3	(2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear
IEEE C37.34	(1994) Standard Test Code for High-Voltage Air Switches
IEEE C37.41	(2008; Errata 2009) Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories Used with These Devices
IEEE C37.90.1	(2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(2008; INT 2009) Standard Requirements for Instrument Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60255-21-3	(1993; ED 1.0) Electrical Relays - Part 21: Vibration, Shock, Bump And Seismic Tests On Measuring Relays And Protection Equipment - Section 3: Seismic Tests

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA FB 1	(2012) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 7	(2013) Standard for Smooth-Wall Coilable

	Electrical Polyethylene Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Reprint Jun 2013) Medium-Voltage Power Cables
UL 1242	(2006; Reprint Jul 2012) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 2515	(2009; Reprint Sep 2012) UL Standard for Safety Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2013) Wire Connectors
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013) Metallic Outlet Boxes
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 854	(2004; Reprint Sep 2011) Standard for Service-Entrance Cables

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-Built Drawings; G

SD-03 Product Data

Fault Current Analysis; G
Protective Device; G
Coordination Study; G
Nameplates; G

Material and Equipment; G
Installation Requirements; G

SD-06 Test Reports

Factory Tests
Field Testing
Operating Tests
Cable Installation

SD-07 Certificates

Material and Equipment
Cable Joints

1.3 QUALITY ASSURANCE

1.3.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

(1) Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

(2) Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

(3) Detail drawings shall as a minimum depict the installation of the following items:

(a) Medium-voltage cables and accessories including cable installation plan.

(b) Transformers.

(c) Substations.

(d) Switchgear.

1.3.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide 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. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.4 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS ANSI O5.1. Handle wood poles in accordance with ATIS ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide material and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

a. Submit a complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

b. Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms.

c. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

2.2 NAMEPLATES

Submit 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.

2.2.1 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate 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. If transformer nameplate is not so marked, furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A153/A153M and ASTM A123/A123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072 Cables shall be manufactured for use in ductordirect burial applications as indicated.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage as indicated.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding

2.4.1.4 Insulation

Cable insulation shall be cross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of AEIC CS8 ethylene-propylene-rubber (EPR) insulation conforming to the requirements of AEIC CS8. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor

shield, a semiconducting insulation shield, and an overall copper tape wire shield for each phase. The shield tape wire shall be sized to meet IEEE C2 requirements for a ground fault

2.4.1.6 Neutrals

Neutral conductors of shall be copper . employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a PVCpolyethylene jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B3 and ASTM B8Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 7.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE 404. Medium-voltage cable terminations shall comply with IEEE 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages

up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE 386 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE 48 for the next higher Basic Insulation Level (BIL) level..

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application.Duct lines shall be concrete-encased, thin-wall type.Duct lines shall be nonencased direct-burial, thick-wall type.Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines.Low-voltage lines or Communication lines run elsewhere may be direct-burial, thick-wall type. Where concrete encasement is not required, low-voltage circuits may utilize factory-installed cable in coilable plastic duct.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Bituminized Fiber Duct

UL 2515 for Type II (Thickwall).

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 & 8 Type EB.

2.6.2.3 Direct Burial

UL 651 Schedule 40andSchedule 80as indicated, or NEMA TC 6 & 8 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C478, ASTM C478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast

iron shall comply with ASTM A48/A48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Secondary Unit Substation

Secondary unit substations shall comply with IEEE C37.121 and shall be of the radial type. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection at the site. Complete sections shall include incoming, transformer, and outgoing sections and, where practicable, shall be shipped as one unit.

2.9 2.10 GROUNDING AND BONDING

2.10.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feetin length. Sectional type rods may be used.

2.10.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.11 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE.

2.12 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM APP GUIDE as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.12.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of

less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.12.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.12.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.13 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D923 and have tests performed in accordance with ASTM D4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.14 FACTORY TESTS

Submit certified factory test reports when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included. Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard designandother tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEC 60255-21-3. Surge withstand tests in accordance with IEEE C37.90.1.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

2.15 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment 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 three years. 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.

2.15.1 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. for main electric supply substations.

2.15.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Utilize the fault current availability indicated as a basis for fault current studies.

2.15.3 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. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.15.4 Fault Current Analysis

2.15.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE 242, and IEEE 399.

2.15.4.2 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.

2.15.5 Coordination Study

Submit the study with protective device equipment submittals. No time extension 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 will not be 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. The study shall demonstrate that the maximum possible degree of selectively 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; 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 any 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.

2.15.6 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 characteristics curves, current transformer ratios, and relay device numbers and settings;andexisting power system data including time-current characteristic 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 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 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before

performing any work.

3.2 INSTALLATION REQUIREMENTS

As a minimum, submit installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment. Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE.

3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.2.2 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. Furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.3 CABLE AND BUSWAY INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then prepare a checklist of significant requirementswhich shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific

size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation. Submit 6 copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3 Direct-Burial

Medium-voltage cables shall be buried directly in the earth as indicated.

3.3.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.3.3.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 8 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 6 inch layer of backfill shall be of sand. Machine compaction shall not be used within 6 inches of the cable.

3.3.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic

compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.3.3.4 Cable Joints or Splices

Cable joints or splices for Medium-Voltage Cable Joints or Low-Voltage Cable Splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.3.3.5 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

3.3.4 Insect and Rodent Damage

Animal guards shall be installed as shown.

3.3.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3.6 Busway Installation

Busways penetrating walls shall have wall flanges installed on both surfaces of walls. Wall openings shall be approximately 1/4 inch larger than the busway on each of the 4 busway sides, and openings shall be sealed with a suitable compound. Fire barriers shall be provided when penetrating fire rated walls. Fire barriers shall have a rating equal to the fire wall rating. A weather barrier shall be used when a busway penetrates an exterior wall. Busways shall be supported at intervals not exceeding 10 feet and shall be braced to prevent lateral movement.

3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted with a certification that contains the names of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person

recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.5 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

3.5.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.5.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM APP GUIDE. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid

with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.6.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.6.4.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.6.4.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.6.5 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.7 MANHOLES, HANDHOLES, AND PULLBOXES

3.7.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell

shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.7.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.7.3 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.7.4 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.7.5 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.8 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.8.1 Concrete Pads

3.8.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished floorpaving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to

placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.8.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE.

3.8.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.8.3 Fencing

Fences shall provide working clearances for operation and maintenance in accordance with IEEE C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables, conduits shall be sealed with caulking compoundto prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground mat consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed under pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer,a switchgear ground bus,a unit

substation to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

3.11 FIELD TESTING

Submit a proposed field test plan, 20days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer ___10__ days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. 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. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS8 or AEIC CS8 as applicable, and shall not exceed the recommendations of IEEE 404 for cable joints and IEEE 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.4 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation 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 shall be retested until failures have been eliminated.

3.11.5 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual and electricaloperation of the breaker.

3.11.7 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.

3.11.8 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation
b. Pad-mounted transformers
c.
d.
e. Metal-enclosed switchgear
f. Busways
g. Switches

3.11.9 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. Submit 6 copies of the tests report in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. The operating test report shall include the following:

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 condition specified for the test.
f. The test results, signed and dated.
g. A description of adjustments made.

3.12 MANUFACTURER'S FIELD SERVICE

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 33 71 02.00 20

UNDERGROUND ELECTRICAL DISTRIBUTION
08/08

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 HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges
AASHTO M 198	(2010) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318M	(2008; Errata 2011) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B231/B231M	(2011) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B400	(2008) Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductor
ASTM B496	(2004e1; R 2010) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors

ASTM B609/B609M	(1999; R 2010) Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B800	(2005) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
ASTM B801	(2007) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C32	(2011) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C857	(2011) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM F 512	(2006) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 386	(2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE 400.2	(2004) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2006) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation

	Rated 2.5 kV through 500 kV
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012) National Electrical Safety Code
IEEE C37.20.3	(2001; R 2006) Standard for Metal-Enclosed Interrupter Switchgear

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-94-649	(2004) Standard for Concentric Neutral Cables Rated 5 Through 46 KV

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI/NEMA WC 71/ICEA S-96-659	(1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA TC 7	(2005) Standard for Smooth-Wall Coilable Electrical Polyethylene Conduit
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical Energy--S95-658
NEMA WC 74/ICEA S-93-639	(2006) 5-46 kV Shielded Power Cable for

	Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; TIA 11-1; Errata 2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758	(2004a) Customer-Owned Outside Plant Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005	(Basic; Notice 2) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Reprint Aug 2011) Medium-Voltage Power Cables
UL 1242	(2006; Reprint Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 510	(2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes
UL 514B	(2004; Reprint Nov 2009) Conduit, Tubing and Cable Fittings
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Reprint Mar 2010) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 651A	(2000; Reprint Feb 2011) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 854	(2004; Reprint Oct 2007) Standard for

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

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 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable joints; G

Medium voltage cable terminations; G

Live end caps; G;

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G

Handhole frames and covers; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

Protective Devices and Coordination Study; G

The study shall be submitted with protective device equipment submittals. No time extension 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.

SD-06 Test Reports

Arc-proofing test for cable fireproofing materials; G

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure

Sixcopies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Cable splicer/terminator; G

Cable Installer Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

1.4.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the

products of the same manufacturer unless stated in this section.

1.4.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.2 Intermediate Metal Conduit

UL 1242.

2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial

UL 651,Schedule 40as indicatedNEMA TC 2, .

2.1.4 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F 512, UL 651A UL 651, EPC-40-PVC or as indicated.

2.1.5 Innerduct

Provide solid wall polyethylene (PE) or PVC innerducts with pullwire. Size as indicated.

2.1.6 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the

common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.7 Fittings

2.1.7.1 Metal Fittings

UL 514B.

2.1.7.2 PVC Conduit Fittings

UL 514B, UL 651NEMA TC 3.

2.1.7.3 PVC Duct Fittings

NEMA TC 9.

2.1.7.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements, or in accordance with NEMA WC 70. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper. Conductors No. 6 AWG and smaller shall be copper. Conductors No. 4 AWG and larger shall be either copper or aluminum, at the Contractor's option. As an exception, do not substitute aluminum for copper if the equivalent aluminum conductor size would exceed 500 kcmil. Should the Contractor choose to use aluminum for conductors No. 4 AWG and larger, the Contractor shall be responsible for: Increasing the conductor size to have the same ampacity as the copper size indicated; increasing the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; ensuring that the pulling tension rating of the aluminum conductor is sufficient; relocating equipment, modifying equipment terminations, resizing equipment, and resolving to the satisfaction of the Contracting Officer problems that are direct results of the use of aluminum conductors in lieu of copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type XHHW or RHW conforming to UL 44. Copper conductors shall be annealed copper complying with ASTM B3 and ASTM B8. Aluminum conductors shall be Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801, and shall be of

an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material). Type EC/1350 is not acceptable. Intermixing of copper and aluminum conductors is not permitted.

2.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.2.4 Direct Buried

Single-conductor and multi-conductor cables shall be of a type identified for direct burial.

2.2.5 In Duct

Cables shall be single-conductor cable. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 7.

2.2.6 Cable Marking

Insulated conductors shall have the date of manufacture , type of conductor, insulation of conductor, location where the cable is being used and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

d. On three-phase, four-wire delta system, high leg shall be orange, as required by NFPA 70.

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply ANSI C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture, type of conductors, insulation of conductors, location where the cable is being used, and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072 metallic armored cables, consisting of three-conductor, multi-conductor cables, with insulation and shielding, as specified, using a galvanized steel interlocked tape armor and thermoplastic jacket. Provide cables manufactured for use in duct applications as indicated. Cable shall be rated 15 kV as indicated with 133 percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B compact round conductors. Provide soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding aluminum alloy 1350 cables, 3/4 hard minimum complying with ASTM B609/B609M and ASTM B231/B231M for regular concentric and compressed stranding or ASTM B400 for compacted stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and AEIC CS8ICEA S-94-649 tree-retardant cross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of NEMA WC 74/ICEA S-93-639 and AEIC CS8 ICEA S-94-649.

2.5.4 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase.

2.5.5 Neutrals

Neutral conductors of shall be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. Concentric neutrals conductors shall be copper, having a combined ampacity equal to the phase conductor ampacity rating.

2.5.6 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial. Provide type UD cables with an overall jacket. Provide PVC jackets with a separator that prevents contact when underlying semiconducting insulating shield.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations shall be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations shall be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator shall be a one-piece design, utilizing the manufacturer's latest

technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination shall be designed for installation in low or highly contaminated indoor or outdoor locations.

2.6.3 Separable Insulated Connector Type

IEEE 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points.

b. 600 Ampere deadbreak connector ratings: Voltage: 15 kV, 95 kV BIL. Short time rating: 25,000 rms symmetrical amperes. Connectors shall have 200 ampere bushing interface for surge arresters.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints shall be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

2.7.2 Cold-Shrink Rubber-Type Joint

Joint shall be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions.

2.8 LIVE END CAPS

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. End cap shall conform to applicable portions of IEEE 48.

2.9 TAPE

2.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.9.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK

2.9.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.10 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.11.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Aluminum is not acceptable.

2.12 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE . In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.13 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and

ASTM C478. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.13.1 Cast-In-Place Concrete Structures

Concrete shall conform to Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE . Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

2.13.2 Precast Concrete Structures, Risers and Tops

In lieu of cast-in-place, Contractors, at their option, may provide precast concrete underground structures subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.13.2.1 General

Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.13.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads shall include full dead, superimposed dead, and

live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.13.2.3 Construction

Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.13.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.13.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.13.4 Handhole Frames and Covers

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of stainless steel with bronze hinge pin , 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

2.13.5 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C32, Grade MS.

2.13.6 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass.

2.14 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.14.1 Cable Racks

The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.14.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 8 inches and a maximum of 12 inches.

2.14.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.15 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags shall be polyethylene. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.15.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F.

Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.16 CABLE TERMINATING CABINETS

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Cabinets shall be provided with with 600 A. dead-break junctions and elbow-type separable dead-break connectors, cable parking stands, and grounding lugs. Provide cable terminating equipment in conformance with IEEE 386.

Ratings at 60 Hz shall be:

Nominal voltage (kV).....

Rated maximum voltage (kV).....15

Rated continuous current (A).....200

Three-second short-time current-carrying capacity (kA).....

BIL (kV).....

2.17 SOURCE QUALITY CONTROL

2.17.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

2.17.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 and CALPUC G.O.128 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit shall be PVC, Type EPC-40 from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete.

3.5.1 Cast-In-Place Concrete Structures

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron

cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 DIRECT BURIAL CABLE SYSTEM

Cables shall be buried directly in the earth below the frostline to the requirements of NFPA 70 and IEEE C2, whichever is more stringent.

3.6.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to

provide the minimum necessary cable cover. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil. Trenches shall be not less than 8 inches wide, and shall be in straight lines between cable markers. Cable plows shall not be used. Bends in trenches shall have a radius consistent with the cable manufacturer's published minimum cable bending radius for the cable installed.

3.6.2 Cable Installation.

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks.

Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart, except that communication cable shall be separated from power cable by a minimum distance of 12 inches.

Where direct-burial cables cross under roads or other paving exceeding5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts . Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition. Where cable is placed in duct(e.g. under paved areas, roads, or railroads), slope ducts to drain.

3.6.3 Splicing

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured. Where splices are required, provide splices designed and rated for direct burial.

3.6.4 Bends

Bends in cables shall have an inner radius not less than those specified in NFPA 70 for the type of cable, or manufacturer's recommendation.

3.6.5 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections. Enclose splices in

lead-sheathed or armored cables in split-type cast-iron splice boxes; after completion of the connection, fill with insulating filler compound and tightly clamp the box.

3.6.6 Identification Slabs Markers

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways, and over each splice. Identification slabs shall be of concrete, approximately 20 inches square by 6 inches thick and shall be set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches above ground. Concrete shall have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures shall be approximately 2 inches high and grooves shall be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top shall include an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape as specified in Section31 00 00 EARTHWORK.

3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

3.7.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger,

draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place.Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Hydraulic jet method shall not be used.

3.7.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.7.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.7.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.7.8 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in

Section 31 00 00 EARTHWORK.

3.7.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.7.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK

3.7.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.9.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.9.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and extend into the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.7.9.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.

Remove existing cables which constitute interference with the work.

3.7.9.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one footapart. Restrain reinforcing assembly from moving during concrete pouring.

3.7.9.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.8 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.10 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.11 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

3.12 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.13 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.14 CABLE END CAPS

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.15 LIVE END CAPS

Provide live end caps for single conductor medium voltage cables where indicated.

3.16 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.16.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.16.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap shall be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and shall extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.17 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms

3.17.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 12 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.17.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other

standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.17.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG. Provide direct connections to the grounding conductor with 600 v insulated, full-size conductor for each grounded neutral of each feeder circuit, which is spliced within the manhole.

3.17.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.17.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.17.6 Fence Grounding

Fences shall be grounded with a ground rod at each fixed gate post and at each corner post. Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 1/8 by one inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.18 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.18.1 Reconditioning of Surfaces

3.18.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in

the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.18.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists , restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.19 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 53 MISCHELLANEOUS CAST-IN-PLACE CONCRETE.

3.19.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.19.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.20 FIELD QUALITY CONTROL

3.20.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.20.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable

termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests shall be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency shall be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages shall be as follows:

CABLE RATING	AC TEST VOLTAGE for ACCEPTANCE TESTING
5 kV	10kV rms(peak)
8 kV	13kV rms(peak)
15 kV	20kV rms(peak)
25 kV	31kV rms(peak)
35 kV	44kV rms(peak)

CABLE RATING	AC TEST VOLTAGE for MAINTENANCE TESTING
5 kV	7kV rms(peak)
8 kV	10kV rms(peak)
15 kV	16kV rms(peak)
25 kV	23kV rms(peak)
35 kV	33kV rms(peak)

3.20.1.2 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.20.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --