



NAVFAC MID-ATLANTIC

eProjects WORK ORDER NO.
1310337

SPECIFICATIONS

Renovate SWOSU Fire Fighter Trainer (Building 510)

At

Naval Station Great Lakes

Great Lakes, Illinois

PREPARED BY:

JACOBS
501 N. Broadway
St. Louis, MO 63102

(A/E Contract N40085-12-D-1703)

Civil: Crowley, Jacobs
Structural: Schroeder
Architectural: Corson, Jacobs
Fire Protection: Beals, Jacobs
Propane: Towery, Jacobs
Mechanical/Plumbing: Crader, Jacobs
Electrical: Fares, Jacobs

Michele Holland, PE
Project Manager, Jacobs

Michele M. Holland
Signature

6/30/2015
Date

Approved by:

For Commander, NAVFAC Mid-Atlantic
BLTL: David W. Greenfield, R. A.
Northeast IPT Capital Improvements

Signature

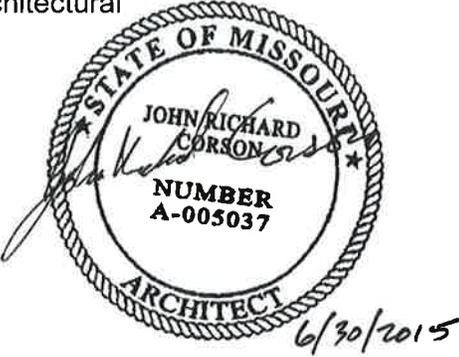
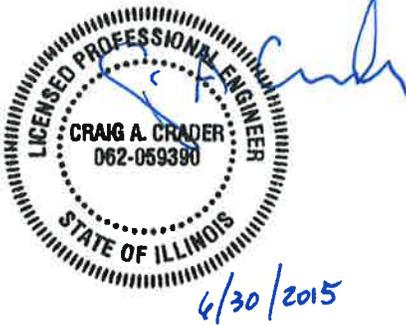
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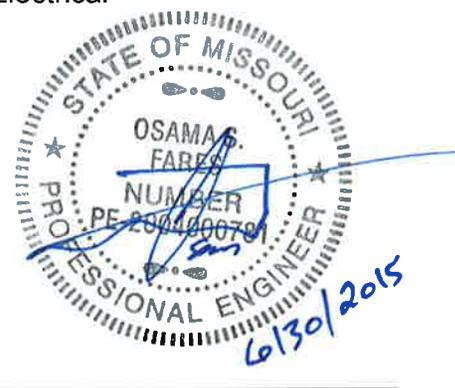
A/E DESIGN CERTIFICATION

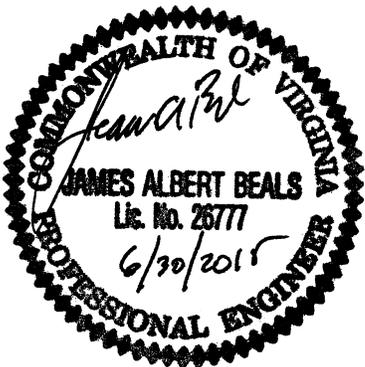
Renovate SWOSU Fire Fighter Trainer (Building 510)

A/E Contract N40083-14-D-0016

<p>Civil</p>  <p>Robert Crowley, P.E. Civil Engineer</p> <p>Jacobs</p>	<p>Structural</p>  <p>Jason Schroeder, P.E. Structural Engineer</p> <p>Jacobs</p>
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<p>Architectural</p>  <p>John Corson, AIA, LEED GA Architect</p> <p>Jacobs</p>	<p>Mechanical / Plumbing</p>  <p>Craig Crader, P.E. Mechanical Engineer</p> <p>Jacobs</p>
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<p>Propane</p>  <p>James O. Towery, P.E. Mechanical Engineer</p> <p>Jacobs</p>	<p>Electrical</p>  <p>Osama Fares, P.E. Electrical Engineer</p> <p>Jacobs</p>
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<p>Fire Alarm</p>  <p>James Beals, P.E. Fire Protection Engineer</p> <p>Jacobs</p>	<p>Jacobs</p>
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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:

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DWG NO.

GENERAL

12689563	G-000	1	COVER SHEET
12689564	G-001	2	GENERAL INFORMATION
12689565	G-002	3	LIFE SAFETY ANALYSIS
12689566	G-100	4	SITE LIFE SAFETY PLAN
12689567	G-101	5	BASEMENT FLOOR LIFE SAFETY PLAN
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12689569	G-103	7	SECOND FLOOR LIFE SAFETY PLAN
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12689581	S-103	19	PARTIAL FIRST FLOOR PLAN
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12689589	A-103	27	PARTIAL SECOND FLOOR PLAN - NORTH
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12689591	A-106	29	PARTIAL ROOF PLAN
12689592	A-501	30	DETAILS
12689593	A-502	31	DETAILS

NAVFAC DWG NO.	DWG NO.	SHT.NO.	TITLE
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12689596	FA-102	34	FIRST FLOOR PLAN
12689597	FA-103	35	SECOND FLOOR PLAN
12689598	FA-104	36	THIRD FLOOR PLAN
12689599	FA-501	37	DETAILS
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12689603	P-104	41	PARTIAL SECOND FLOOR CRAWL SPACE PLAN
12689604	P-105	42	PARTIAL SECOND FLOOR PLAN
12689605	P-106	43	PARTIAL THIRD FLOOR PLAN
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12689612	MD104	50	PARTIAL SECOND FLOOR DEMOLITION PLAN
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12700891	E-103	71	PARTIAL PARTIAL SECOND FLOOR CRAWL SPACE
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1.3 SUPPLEMENTARY DRAWINGS

These supplementary drawings may not be a part of the contract but are included with the drawings for information.

1.3.1 Reference Drawings

The following reference drawings are intended only to show the original construction. Drawings are the property of the Government and shall not be used for any purpose other than that intended by the contract. Information on procuring these full-size drawings may be obtained from the Contracting Officer.

NAVFAC DWG NO.	DWG NO.	SHT.NO.	TITLE
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5276452	U5-1	28	TANK YARD - 12,000 GAL PROPANE STORAGE FOUNDATION
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5354856	M2-5B	136	BASEMENT-NORTH PIPING PLAN
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5354857	M2-65	138	FIRST FLOOR-NORTH PIPING PLAN
5276557	M2-7A	139	SECOND FLOOR-NORTH DUCTWORK PLAN
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5354859	M2-8B	142	THIRD FLOOR-NORTH PIPING PLAN
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5354861	M2-10B	146	BASEMENT-NORTH PARTIAL MECHANICAL ROOM PIPING PLAN
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5276562	M3-2	148	LOOKING EAST HVAC NORTH - SOUTH SECTION
5276563	M3-3	149	LOOKING SOUTH HVAC EAST - WEST SECTION
5276564	M3-4	150	LOOKING WEST HVAC NORTH - SOUTH SECTION
5276565	M3-5	151	COOLING TOWER AND MECH RM HVAC DETAILS AND SECTIONS
5276566	M3-6	152	HVAC DUCTWORK DETAILS
5276567	M3-7	153	HVAC STEAM SYSTEM DETAILS
5276568	M3-8	154	HVAC WATER PIPING DETAILS
5276569	M3-9	155	HVAC PIPING DETAILS
5276570	M3-10	156	LOOKING NORTH HVAC EAST-WEST SECTION
5276571	M4-1	157	FFT CONTROL ITEM DESCRIPTIONS AND CONTROL LEGEND
5276572	M4-2	158	FFT FACEPLATE DETAIL FOR DATA TERMINAL CABINET
5276573	M4-3	159	FFT FAN HTEF-1,2,3,4 AND 8 WIRING DIAGRAMS
5276574	M4-4	160	FFT FAN HTEF-5,6,7 AND 9 WIRING DIAGRAMS
5276575	M4-5	161	FFT HVU-1 THRU HVU-7 AND MISC EXHAUST FANS WIRING DIAGRAMS
5276576	M4-6	162	FFT CRAWL SPACE CONTROLS AND WIRING DIAGRAMS
5276577	M4-7	163	FFT PLC1,2,3,4,5 LOGIC SCHEDULES AND LOGIC DESCRIPTIONS
5276578	M5-1	164	HVAC VAV SYSTEM DIAGRAM AND SEQUENCE OF OPERATION
5276579	M5-2	165	HVAC HEAT PUMP SYSTEM DIAGRAM AND SEQUENCE OF OPERATION
5276580	M5-3	166	HVAC HEATING AND VENT DIAGRAMS AND SEQUENCE OF OPERATION
5276581	M5-4	167	HVAC VENTILATION DIAGRAMS AND SEQUENCE OF OPERATION
5276582	M5-5	168	HVAC COOLING SYSTEM DIAGRAMS AND SEQUENCE OF OPERATION
5276583	M5-6	169	HVAC HEATING SYSTEM DIAGRAM AND SEQUENCE OF OPERATION
5276584	M5-7	170	HEATING SYSTEM HVAC DIAGRAM
5276585	M6-1	171	TOWER, CHILLER, PUMP, ACU, HE HVAC EQUIPMENT SCHEDULES
5276586	M6-2	172	HVU, HP, FILTER, COIL HVAC EQUIPMENT SCHEDULES
5276587	M6-3	173	SUPPLY AND EXHAUST FANS HVAC EQUIPMENT SCHEDULES
5276588	M6-4	174	VAV TERMINAL UNIT HVAC EQUIPMENT SCHEDULES
5276589	M6-5	175	CABINET AND UNIT HEATER HVAC EQUIPMENT SCHEDULES

NAVFAC DWG NO.	DWG NO.	SHT.NO.	TITLE
5276590	M6-6	176	SILENCER, GR, REG, DIFF, BASEBOARD HVAC EQUIPMENT SCHEDULES
PLUMBING/PROCESS PIPING			
5276591	PO-1	177	PLUMBING SYMBOLS AND ABBREVIATIONS
5276592	P1-1	178	UNDERFLOOR PLAN AND FIRST FLOOR CRAWL SPACE - SOUTH
5276593	P1-2	179	FIRST FLOOR PLAN AND SECOND FLOOR CRAWL SPACE - SOUTH
5276594	P1-3	180	SECOND FLOOR AND THIRD FLOOR PLAN - SOUTH
5276595	P1-4	181	UNDERFLOOR PLAN - NORTH
5276596	P1-5	182	BASEMENT FLOOR PLAN - NORTH
5276597	P1-6	183	FIRST FLOOR PLANS - NORTH
5276598	P1-7	184	SECOND FLOOR PLAN - NORTH
5276599	P1-8	185	THIRD FLOOR PLAN - NORTH
5276600	P1-9	186	PUMP ROOM - UPPER AND LOWER PLANS - NORTH
5276601	P1-10	187	FIRST AND SECOND FLOOR PLAN - DAMAGE CONTROL TRAINER - NORTH
5276602	P1-11	188	PARTIAL PLANS
5276603	P2-1	189	PLUMBING RISER DIAGRAMS
5276604	P2-2	190	PLUMBING RISER DIAGRAMS
5276605	P2-3	191	PROCESS WATER DIAGRAM
5276606	P3-1	192	PIPING DETAILS
5276607	P3-2	193	PIPING DETAILS
5276608	P3-3	194	AFFF SYSTEM SCHEMATIC AND DETAILS
5276609	P3-4	195	DAMAGE CONTROL TRAINER SECTIONS AND ELEVATIONS EAST/WEST
5276610	P3-5	196	DAMAGE CONTROL TRAINER EAST ELEVATION
5276611	P3-6	197	PROCESS TANK ROOM WEST ELEVATION
5276612	P4-1	198	PLUMBING SCHEDULES
FIRE PROTECTION			
5276613	FP0-1	199	FIRE PROTECTION SYMBOLS, SCHEDULES AND ABBREVIATIONS
5276614	FP1-1	200	FIRST FLOOR CRAWL SPACE AND FIRST FLOOR PLAN - SOUTH
5276615	FP1-2	201	SECOND AND THIRD FLOOR PLAN - SOUTH
5276616	FP1-3	202	BASEMENT FLOOR PLAN - NORTH
5276617	FP1-4	203	FIRST FLOOR PLAN - NORTH
5276618	FP1-5	204	SECOND FLOOR PLAN - NORTH
5276619	FP1-6	205	THIRD FLOOR PLAN - NORTH
5276620	FP2-1	206	FIRE PROTECTION DIAGRAMS AND DETAILS
ELECTRICAL			
5276621	E0-1	207	ELECTRICAL SYMBOL LIST
5276622	E0-2	208	GENERAL NOTES AND ABBREVIATIONS
5276623	E1-1	209	ELECTRICAL RISER DIAGRAM
5276624	E1-2	210	MISCELLANEOUS SYSTEM DIAGRAMS
5276625	E2-1	211	SITE PLAN
5276626	E3-1	212	FIRST FLOOR AND FIRST FLOOR CRAWL SPACE SOUTH LIGHTING
5276627	E3-2	213	SECOND FLOOR AND SECOND FLOOR CRAWL SPACE SOUTH LIGHTING
5276628	E3-3	214	THIRD FLOOR - SOUTH LIGHTING
5276629	E3-4	215	BASEMENT - NORTH LIGHTING
5276630	E3-5	216	FIRST FLOOR - NORTH LIGHTING
5276631	E3-6	217	SECOND FLOOR - NORTH LIGHTING
5276632	E3-7	218	THIRD FLOOR - NORTH LIGHTING
5276633	E4-1	219	FIRST FLOOR AND FIRST FLOOR CRAWL - SOUTH POWER AND MISC. AND RECEP.

NAVFAC DWG NO.	DWG NO.	SHT.NO.	TITLE
5276634	E4-2	220	SECOND FLOOR AND SECOND FLOOR CRAWL SPACE - SOUTH POWER AND MISC.
5276635	E4-3	221	THIRD FLOOR AND ROOFTOP POWER AND MISCELLANEOUS
5276636	E4-4	222	BASEMENT - NORTH POWER AND MISCELLANEOUS
5276637	E4-5	223	FIRST FLOOR - NORTH POWER AND MISCELLANEOUS
5276638	E4-6	224	SECOND FLOOR - NORTH POWER AND MISCELLANEOUS
5276639	E4-7	225	THIRD FLOOR - NORTH POWER AND MISCELLANEOUS
5276640	E4-8	226	ROOF - NORTH POWER AND MISCELLANEOUS
5276641	E5-1	227	MOTOR CONTROL SCHEDULE
5276642	E5-2	228	MOTOR CONTROL SCHEDULE
5276643	E6-1	229	PANEL SCHEDULES
5276644	E6-2	230	PANEL SCHEDULES
5276645	E6-3	231	PANEL SCHEDULES
5276646	E6-4	232	PANEL SCHEDULES
5276647	E7-1	233	LIGHTING FIXTURE DETAILS
5276648	E7-2	234	LIGHTING FIXTURE DETAILS
5276649	E7-3	235	LIGHTING FIXTURE DETAILS
5276650	E8-1	236	DETAILS
5276651	E8-2	237	DETAILS
5276652	E8-3	238	DETAILS

-- End of Document --

SECTION 01 11 00

SUMMARY OF WORK

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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1 (2011; Errata 1-2 2012; INT 1 2013; Errata 3-8 2013) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 008 (2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

ASTM INTERNATIONAL (ASTM)

ASTM E2114 (2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

U.S. DEPARTMENT OF ENERGY (DOE)

ISWG Guiding Principles (2008) High Performance and Sustainable Buildings Guidance

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

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E2114, 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.

1.3 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

Upon receipt of Government Furnished Equipment, the Contractor shall submit records in accordance with paragraph entitled, "Government Furnished Property," of this section.

Submit the following items to the Contracting Officer:

- Utility Outage Requests
- Utility Connection Requests
- Borrow Permits
- Excavation Permits
- Welding Permits

SD-07 Certificates

Energy Performance Rating

1.4 WORK COVERED BY CONTRACT DOCUMENTS

1.4.1 Project Description

The work includes the renovation of the Surface Warfare Officer's School Unit (SWOSU) 19F3C Fire Fighter Trainer within Building 510 at Naval Station Great Lakes. The renovation includes:

- Propane work including testing and a replacement of all underground piping; replacement of all exterior above-ground piping, valves, sensors; replacement of all interior piping up to burner control cabinets; replacement of valves, sensors at truck transfer station; addition of new emergency shutoff station; shifting of propane from one tank to another (and back again), allowing for replacement of "saddles" beneath tanks and replacement of tank valves; replacement of valves, actuators, CO2 lines at tanks; replacement of vaporizers, valves, and sensors at vaporizer station; repair of CO2 system at vaporizer station; replacement of valves, regulators, pressure switches, and pressure gauges at Block and Vent Station.
- Mechanical work including repair/refurbishment of High-Temperature Exhaust Fans (HTEF), dampers, and ductwork; replacement of AHU lagging; replacement of propane detectors; refurbishment of make-up air units and ductwork; replacement of existing DTC building controls with digital controls; replacement of low water sensors; replacement of chemical metering pumps;

- Electrical work including installation of new lights; replacement of Variable Frequency Drives (VFDs); replacement of damaged conduit and boxes;
- Structural repairs to concrete and steel beams and concrete walls; replacement of steel grating; replacement and addition of refractory panels and steel plate shielding; repair and sealing of concrete chamfer cants; repairs to miscellaneous cracks in concrete floors; repairs to cracks in concrete tank walls; minor handrail repairs;
- Architectural repairs to patch/repair and replacement of existing modified bitumen roof; patch/repair of EPDM roof; minor repairs, sealing, painting of floor and walls in Wild Hose Room;
- Miscellaneous plumbing work including cleaning process water strainers; replacement of media in process water strainers; addition of new floor drains; addition of new roof drain;
- Minor fire alarm repairs including the addition of some sensors, horns, and strobes;
- Commissioning of various systems, including: building controls, HVAC (including HTEF, Heat Pumps, Make Up Air Units, Dampers, Chlorine Ventilation System), Domestic and Process Water, Propane, Fire Alarm;

Note that the burner controls, propane controls, and other "fire fighter trainer unique equipment" are controlled by Programmable Logic Controllers (PLCs) which will be installed under a separate, concurrent contract. PLCs will initiate command to BAS to control of the HTEFs and other building systems as required to facilitate training operations. Project schedule and commissioning will require interfacing and coordinating with this separate contractor. Refer to Section 01 91 00.00 40 COMMISSIONING for details.

1.4.2 Location

The work shall be located at Building 510 at Naval Station Great Lakes, Great Lakes, IL. Interior work is anticipated to occur in the basement below the DTC/Wet Trainer (north end of the building) and in all levels of the 19F3C Trainer (south end of the building). Exterior work for the propane system will occur at the south and southwest ends of the building, as well as at the transfer station, tanks, and vaporizer station immediately across the road east of the building, approximately as indicated. The exact location will be shown by the Contracting Officer.

1.5 PROJECT ENVIRONMENTAL GOALS

Contractor shall distribute copies of the Environmental Goals to each subcontractor and the Contracting Officer. The overall goal for design, construction, and operation is to produce a building that meets the functional program needs and incorporates the principles of sustainability. Specifically:

- a. Preserve and restore the site ecosystem and biodiversity; avoid site degradation and erosion. Minimize offsite environmental impact.
- b. Use the minimum amount of energy, water, and materials feasible to meet the design intent. Select energy and water efficient equipment and strategies.

- c. Use environmentally preferable products and decrease toxicity level of materials used.
- d. Use renewable energy and material resources.
- e. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of building systems.
- f. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the building.
- g. Reduce construction waste through reuse, recycling, and supplier take-back.
- h. Provide work consistent with drawings in order to meet Energy Performance Rating via Energy Star in accordance with design. In addition, incorporate each of the following ISWG Guiding Principles Requirements into project construction. Items below are organized according to the ISWG Guiding Principles.

1.6 OCCUPANCY OF PREMISES

Building(s) 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.

1.6.1 Commissioning

Work with the Commissioning Authority (CxA) to achieve requirements of the Commissioning plan and other contract document requirements at each stage of commissioning. Maintain up-to-date records of commissioning activities in the Sustainability Notebook, to include commissioning plan and summary commissioning report.

1.6.2 Energy Efficient Equipment

Provide only energy-using equipment that is Energy Star rated, or has the Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide equipment with efficiency in the top 25 percent for the type of equipment procured. Provide only energy using equipment that meets FEMP requirements for low standby power consumption. Energy efficient equipment can be found at: <http://www1.eere.energy.gov/femp/> and <http://www.energystar.gov/>. Provide the following documentation:

Proof that equipment is energy efficient and complies with the cited requirements.

1.6.3 Reduce Volatile Organic Compounds (VOC)

Provide materials and products with low pollutant emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings. Meeting the requirements of ASHRAE 189.1 Sections 8.4.2 (Prescriptive Option: Materials) or Section 8.5.2

(Performance Option: Materials) demonstrates compliance. Provide the following documentation:

- a. Demonstrate that materials do not exceed maximum VOC emissions of cited standards. VOC averaging is allowed where coatings are subject to human contact or harsh environmental conditions.
- b. Demonstrate that flooring materials comply with VOC emissions of cited standards.
- c. Demonstrate that composite wood and agrifiber products and associated laminating adhesives contain no added urea-formaldehyde.
- d. Demonstrate that furniture and seating complies with low emissions requirements.
- e. Create and maintain a list of above listed products used on the project within the building vapor barrier. Demonstrate how product meets cited standards.

1.6.4 Indoor Air Quality During Construction

Prior to construction, create indoor air quality plan. Implement IAQ plan during construction and flush building air before occupancy.

- a. Construction submittal documentation required:
 - (1) For new construction and for renovation of unoccupied existing buildings, comply with ASHRAE 189.1 Section 10.3.1.4. (Indoor Air Quality (IAQ) Construction Management), with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. For renovation of occupied existing buildings, comply with ANSI/SMACNA 008 IAQ Guidelines for Occupied Buildings Under Construction.
 - (2) Provide required documentation showing that after construction ends and prior to occupancy, new HVAC filters were installed, and building air was flushed out in accordance with UFC 1-200-02.

1.6.5 Recycled Content

Provide materials on this project with aggregated total recycled content greater than 10 percent. In addition, comply with 40 CFR 247. Refer to <http://www.epa.gov/cpg/products.htm> for assistance identifying products cited in 40 CFR 247. Provide the following documentation:

- a. Total amount of recycled content contained in building materials as a percentage of total cost of all building materials on the project (mechanical, electrical, and plumbing components, fire protection equipment and transportation are excluded).
- b. Substitutions: Contractor may submit for Government approval, proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions, submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.

1.6.6 Bio-Based Products

Utilize products and material made from biobased materials to the maximum extent possible without jeopardizing the intended end use or detracting from the overall quality delivered to the end user. Use only supplies and materials of a type and quality that conform to applicable specifications and standards.

Biobased products that are designated for preferred procurement under the USDA BioPreferred Program must meet the required minimum biobased content. Refer to <http://www.biopREFERRED.gov> for the product categories and BioPreferred Catalog. Provide the following documentation:

- a. For biobased products used on this project, provide biobased content and biobased source of material. Indicate name of the manufacturer, cost of each product and the use of each product on this project.

1.6.7 Landfill Disposal

Divert construction debris from landfill disposal in accordance with Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS. Provide the following documentation:

- a. Documentation showing total amount of construction debris diverted from landfill as a percentage of all construction debris on the project.
- b. Include project's Construction Waste Management Plan and all dumpster haul tickets.

1.6.8 Ozone Depleting Substances

Eliminate the use of ozone depleting substances during and after construction where alternative environmentally preferable products are available. Meet the requirements of ASHRAE 189.1 Section 9.3.3 Refrigerants for no CFC-based refrigerants in heating ventilation, air conditioning and refrigeration systems (except for fire suppression system requirements, covered elsewhere in this specification). Provide the following documentation:

- a. MSDS sheets for all refrigerants provided
- b. Products that meet the criteria of U.S. EPA Significant New Alternatives Policy, available at <http://www.epa.gov/ozone/snap/index.html>.

1.6.9 Validation and Certification Restrictions

The Contractor's purchase of renewable energy certificates (RECs) specifically to meet project sustainability goals is prohibited.

1.7 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
- b. Repair or replace portions of existing work which have been

altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.8 ON-SITE PERMITS

1.8.1 Utility Outage Requests and Utility Connection Requests

Notify the Contracting Officer at least 72 hours prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

Work shall be scheduled to hold outages to a minimum.

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 15 calendar days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.8.2 Borrow, Excavation, Welding, and Burning Permits

<u>ACTIVITY</u>	<u>SUBMISSION DATE</u>
Borrow Permits	15 calendar days prior to work
Excavation Permits	15 calendar days prior to work
Welding Permits	15 calendar days prior to work

Permits shall be posted at a conspicuous location in the construction area.

Burning of trash or rubbish is not permitted at Naval Station Great Lakes.

1.9 LOCATION OF UNDERGROUND UTILITIES

Obtain digging permits prior to start of excavation by contacting the Contracting Officer 15 calendar days in advance. Scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground, or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground or encased obstruction not indicated to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

PART 2 PRODUCTS

Not used.

Renovate SWOSU Fire Fighter Trainer (Building 510)
Naval Station Great Lakes, Great Lakes, IL

WON 1310337

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS

11/11

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Contact Personnel; G

1.2 SPECIAL SCHEDULING REQUIREMENTS

- a. The B510 will remain in operation during the entire construction period. The Contractor must conduct his operations so as to cause the least possible interference with normal operations of the activity.
- b. The work under this contract requires special attention to the scheduling and conduct of the work in connection with existing operations. Identify on the construction schedule each factor which constitutes a potential interruption to operations.

The following conditions apply:

- (1) Power outages.
 - (2) Road closures are subject to approval. Provide minimum 15 days notice for road outages.
 - (3) Points of access, route to work areas, route for delivery of materials, and areas for laydown shall be as directed by the Contracting Officer.
 - (4) High noise activities, such as demolition.
- c. The work under this contract requires special attention to scheduling and conduct of the work in connection with a separate, concurrent contract that will address "trainer specific" items within the facility. Final commissioning of key systems will require participation and coordination of both contractors. Identify on the construction schedule each factor which constitutes a point of coordination, handover, or milestone that impacts this separate contract. Key contract milestones include:
 1. Holiday shutdown (Basement/Wet Trainer area available for work): 12/18/15 - 1/3/16
 2. Trainer area available for work (i.e., all equipment, conduit, etc., removed): 1/25/16
 3. Trainer interior work complete and handed over: 6/13/16.
Note: Handover of interior ONLY. Access to roof will be provided.

4. Propane system flushed and active: 8/15/16
 5. Exterior work complete and ready for final (joint) testing/commissioning: 9/14/16
 6. Project complete: 10/18/16
- d. Note that access to the courtyard will be shared between both contractors at all times.
- e. Work in the basement/wet trainer area must be conducted outside operating hours for the trainer. The work can be performed during the Holiday shutdown and/or on nights or weekends. Identify on the construction schedule any night/weekend work proposed to complete this work.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. To minimize traffic congestion, delivery of materials must be outside of peak traffic hours 6:30 to 8:00 a.m. and 3:30 to 5:00 p.m. unless otherwise approved by the Contracting Officer and must be made through the rear gate of the base. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. Mark Contractor equipment for identification.

1.3.1.1 Subcontractors and Personnel Contacts

Provide a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.3.1.2 Identification Badges and Installation Access

Application for and use of badges will be as directed. Obtain access to the installation by participating in the Navy Commercial Access Control System (NCACS), or by obtaining passes each day from the Base Pass and Identification Office. Costs for obtaining passes through the NCACS are the responsibility of the Contractor. One-day passes, issued through the Base Pass and Identification Office, will be furnished without charge. 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/portal/site/uscis> by searching or selecting Employment Verification (Form I-9) _____. Immediately report instances of lost or stolen badges to the Contracting Officer.

- a. NCACS Program: NCACS is a voluntary program in which Contractor personnel who enroll, and are approved, are subsequently granted access to the installation for a period up to one year, or the length of the contract, whichever is less, and are not required to obtain a new pass from the Base Pass and Identification Office for each visit. The Government performs background screening and credentialing. Throughout the year the Contractor employee must continue to meet background

screening standards. Periodic background screenings are conducted to verify continued NCACS participation and installation access privileges. Under the NCACS program, no commercial vehicle inspection is required, other than for Random Anti-Terrorism Measures (RAM) or in the case of an elevation of Force Protection Conditions (FPCON). Information on costs and requirements to participate and enroll in NCACS is available at <http://www.rapidgate.com> or by calling 1-877-727-4342. Contractors should be aware that the costs incurred to obtain NCACS credentials, or costs related to any means of access to a Navy Installation, are not reimbursable. Any time invested, or price(s) paid, for obtaining NCACS credentials will not be compensated in any way or approved as a direct cost of any contract with the Department of the Navy.

- b. One-Day Passes: Participation in the NCACS is not mandatory, unless otherwise specified, and if the Contractor chooses to not participate, the Contractor's personnel will have to obtain daily passes, be subject to daily mandatory vehicle inspection, and will have limited access to the installation. The Government will not be responsible for any cost or lost time associated with obtaining daily passes or added vehicle inspections incurred by non-participants in the NCACS.

1.3.1.3 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installation, 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.

1.3.2 Working Hours

Regular working hours must consist of an 8 1/2 hour period, between 7 a.m. and 5:00 p.m., Monday through Friday, excluding Government holidays.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 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 regular hours. During periods of darkness, the different parts of the work must be lighted in a manner approved by the Contracting Officer.

1.3.4 Occupied and Existing Building

The Contractor shall be working in an existing building which is occupied.

Provide dust covers or protective enclosures to protect existing work that remains and Government material located in the B510 during the construction period.

Relocate movable furniture approximately 6 feet away from the Contractor's working area as required to perform the work, protect the furniture, and replace the furniture in its original locations upon completion of the work.

Leave attached equipment in place, and protect it against damage.

The Government will remove other Government property in the areas of the building scheduled to receive work. Note that some materials will remain in the crawl spaces (conduits, receptacles, etc.) with the understanding these will not impede the Contractor's work in these areas.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 20 00.00 20

PRICE AND PAYMENT PROCEDURES

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP-1110-1-8 (2009) Construction Equipment Ownership
and Operating Expense Schedule

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

Earned Value Report; G

1.3 EARNED VALUE REPORT

1.3.1 Data Required

This contract requires the use of a cost-loaded Network Analysis Schedule (NAS). The information required for the Schedule of Prices will be entered as an integral part of the Network Analysis Schedule. Within 15 calendar days of notice of award, prepare and deliver to the Contracting Officer an Earned Value Report (construction contract) as directed by the Contracting Officer. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices. Costs shall be summarized and totals provided for each construction category.

1.3.2 Schedule Instructions

Payments will not be made until the Earned Value Report from the cost-loaded NAS has been submitted to and accepted by the Contracting Officer. Identify the cost for site work, and include incidental work to the 5 ft line. Identify costs for the building(s), and include work out to the 5 ft line. Work out to the 5 ft line shall include construction encompassed within a theoretical line 5 ft from the face of exterior walls and shall include attendant construction, such as pad mounted HVAC cooling equipment, cooling towers, and transformers placed beyond the 5 ft line.

1.3.3 Schedule Requirements for HVAC TAB

The field work Section 23 05 93 TESTING, ADJUSTING AND BALANCING shall be broken down in the Earned Value Report from the cost-loaded NAS by separate

line items which reflect measurable deliverables. Specific payment percentages for each line item shall be determined on a case by case basis for each contract. The line items shall be as follows:

- a. Approval of Design Review Report: The TABS Agency is required to conduct a review of the project plans and specifications to identify any feature, or the lack thereof, that would preclude successful testing and balancing of the project HVAC systems. The resulting findings shall be submitted to the Government to allow correction of the design. The progress payment shall be issued after review and approval of the report.
- b. Approval of the pre-field engineering report: The TABS Agency submits a report which outlines the scope of field work. The report shall contain details of what systems will be tested, procedures to be used, sample report forms for reporting test results and a quality control checklist of work items that must be completed before TABS field work commences.
- c. Season I field work: Incremental payments are issued as the TABS field work progresses. The TABS Agency mobilizes to the project site and executes the field work as outlined in the pre-field engineering report. The HVAC water and air systems are balanced and operational data shall be collected for one seasonal condition (either summer or winter depending on project timing).
- d. Approval of Season I report: On completion of the Season I field work, the data is compiled into a report and submitted to the Government. The report is reviewed, and approved, after ensuring compliance with the pre-field engineering report scope of work.
- e. Completion of Season I field QA check: Contract QC and Government representatives meet the TABS Agency at the jobsite to retest portions of the systems reported in the Season I report. The purpose of these tests are to validate the accuracy and completeness of the previously submitted Season I report.

1.4 CONTRACT MODIFICATIONS

In conjunction with the Contract Clause "DFARS 252.236-7000, Modification Proposals-Price Breakdown," and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the EP-1110-1-8.

1.5 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.5.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause FAR 52.232-27, Prompt Payment Construction Contracts and FAR 52.232-5, Payments Under Fixed-Price Construction Contracts. The requests for payment shall include the documents listed below.

- a. The Contractor's invoice, on NAVFAC Form 7300/30 furnished by the Government, showing in summary form, the basis for arriving at the amount of the invoice. Form 7300/30 shall include certification by Quality Control (QC) Manager as required by the contract.

- b. The Earned Value Report from the cost-loaded NAS, showing in detail: the estimated cost, percentage of completion, and value of completed performance.
- c. Updated Project Schedule and reports required by the contract.
- d. Contractor Safety Self Evaluation Checklist.
- e. Other supporting documents as requested.
- f. Updated copy of submittal register.
- g. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies.

1.5.2 Submission of Invoices

If NFAS Clause 5252.232-9301 is included in the contract, the documents listed in paragraph "CONTENT OF INVOICE" shall be provided in their entirety as attachments in Wide Area Work Flow (WAWF) for each invoice submitted. The maximum size of each WAWF attachment is two megabytes, but there are no limits on the number of attachments. If a document cannot be attached in WAWF due to system or size restriction it shall be provided as instructed by the Contracting Officer.

1.5.3 Final Invoice

- a. A final invoice shall be accompanied by the certification required by DFARS 252.247.7023 TRANSPORTATION OF SUPPLIES BY SEA, and the Contractor's Final Release. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary shall certify the Final Release.
- b. For final invoices being submitted via WAWF, the original Contractor's Final Release Form and required certification of Transportation of Supplies by Sea must be provided directly to the respective Contracting Officer prior to submission of the final invoice. Once receipt of the original Final Release Form and required certification of Transportation of Supplies by Sea has been confirmed by the Contracting Officer, the Contractor shall then submit final invoice and attach a copy of the Final Release Form and required certification of Transportation of Supplies by Sea in WAWF.
- c. Final invoices not accompanied by the Contractor's Final Release and required certification of Transportation of Supplies by Sea will be considered incomplete and will be returned to the Contractor.

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

1.6.1 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the Contracting

Officer, be subject to reductions and/or suspensions permitted under the FAR and agency regulations including the following in accordance with "FAR 32.503-6:

- a. Reasonable deductions due to defects in material or workmanship;
- b. Claims which the Government may have against the Contractor under or in connection with this contract;
- c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor; and
- d. Failure to provide up to date record drawings not current as stated in Contract Clause "FAC 5252.236-9310, Record Drawings."

1.6.2 Payment for Onsite and Offsite Materials

Progress payments may be made to the contractor for materials delivered on the site, for materials stored off construction sites, or materials that are in transit to the construction sites under the following conditions:

- a. FAR 52.232-5(b) Payments Under Fixed Price Construction Contracts.
- b. Materials delivered on the site but not installed, including completed preparatory work, and off-site materials to be considered for progress payment shall be major high cost, long lead, special order, or specialty items, not susceptible to deterioration or physical damage in storage or in transit to the construction site. Examples of materials acceptable for payment consideration include, but are not limited to, structural steel, non-magnetic steel, non-magnetic aggregate, equipment, machinery, large pipe and fittings, precast/prestressed concrete products, plastic lumber (e.g., fender piles/curbs), and high-voltage electrical cable. Materials not acceptable for payment include consumable materials such as nails, fasteners, conduits, gypsum board, glass, insulation, and wall coverings.
- c. Materials to be considered for progress payment prior to installation shall be specifically and separately identified in the Contractor's estimates of work submitted for the Contracting Officer's approval in accordance with Earned Value Report requirement of this contract. Requests for progress payment consideration for such items shall be supported by documents establishing their value and that the title requirements of the clause at FAR 52.232-5 have been met.
- d. Materials are adequately insured and protected from theft and exposure.
- e. Provide a written consent from the surety company with each payment request for offsite materials.
- f. Materials to be considered for progress payments prior to installation shall be stored in the Continental United States. Other locations are subject to written approval by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

11/11

PART 1 GENERAL

1.1 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

View location map; G

Progress and completion pictures; G

1.2 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.

1.3 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 a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit a view location sketch indicating points of view. Submit with the monthly invoice two sets of digital photographs each set on a separate 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.

1.4 MINIMUM INSURANCE REQUIREMENTS

Procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

- a. Comprehensive general liability: \$500,000 per occurrence
- b. Automobile liability: \$200,000 per person, \$500,000 per occurrence for bodily injury, \$20,000 per occurrence for property damage
- c. Workmen's compensation as required by Federal and State workers' compensation and occupational disease laws.

- d. Employer's liability coverage of \$100,000, except in States where workers compensation may not be written by private carriers,
- e. Others as required by Illinois law.

1.5 CONTRACTOR SPECIAL REQUIREMENTS

1.5.1 Space Temperature Control, HVAC TAB, and Apparatus Inspection

All contract requirements of Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC, Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC shall be accomplished directly by a first tier subcontractor.

1.6 PROJECT MANAGEMENT AND SUPERVISION

Superintendent:

Provide at least one qualified superintendent on the work site during working hours. The superintendent shall have a minimum of 10 years of experience as a superintendent and have supervised at least two projects of similar size and complexity, including at least one successful project where Propane Systems were installed. The Superintendent shall have no other duties.

Quality Control Manager(QCM):

Provide a QCM for the contract in accordance with requirements of Section 01 45 00.00 20, DESIGN AND CONSTRUCTION QUALITY CONTROL. The QCM shall be on the site at all times, and shall have no other duties.

Site Safety and Health Officer(SSHO):

Provide a SSHO for the contract in accordance with the requirements of Section 01 35 26, GOVERNMENTAL SAFETY REQUIREMENTS. The SSHO shall be on site at all times, and shall have no other duties.

1.7 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices or earned value report, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

1.8 FACILITY TURNOVER PLANNING MEETINGS (NAVFAC Red Zone - NRZ)

Key personnel will meet to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the Pre Construction Conference meeting and convene at the Facility Turnover Meetings once the project has reached approximately 75 percent completion or three to six months prior to Beneficial Occupancy Date (BOD), whichever comes first. The Contracting Officer's Representative will lead the meetings and guide discussions based on an agenda provided by the Government. The facility Turnover effort shall include the following:

- a. Pre Construction Meeting - Contracting Officer's Technical Representative (COTR) will provide the NRZ Checklist and the Contractor, Client, and NAVFAC Representatives will compare Contractor's schedule to NRZ Checklist items.

b. Facility Turnover Meetings

1. Fill in the NRZ Checklist including Contractor, Client, and NAVFAC Checklist Items and assign a person responsible for each item and a due date. The Contractor's Representative will facilitate the assignment of responsibilities and fill out the NRZ Checklist.
2. Review the Contractor's updated schedule. The Contractor shall develop a POAM for the completion of all Contractor, Client, and NAVFAC Checklist items.
3. Confirm that all NRZ Checklist items will be completed on time for the scheduled Facility Turnover.

c. Interim Handover Meetings

As the successful completion of the project will require coordination between both contractors, handover meetings prior to each key handover will be required. The milestones associated with these meetings are designated in 01 14 00 paragraph 1.2c, and are more specifically:

1. Handover of FFT from other contractor, item 1.2c2
2. Handover of interior of FFT to other contractor, item 1.2c3. Note that commissioning will be a joint effort, and separate meetings will be held to coordinate all interfaces for this effort.
3. Fill in the NRZ Checklist including Contractor, Client, and NAVFAC Checklist Items and assign a person responsible for each item and a due date. The Contractor's Representative will facilitate the assignment of responsibilities and fill out the NRZ Checklist.
4. Review the Contractor's updated schedule. The Contractor shall develop a POAM for the completion of all Contractor, Client, and NAVFAC Checklist items.
5. Confirm that all NRZ Checklist items will be completed on time for the scheduled Facility Turnover.

1.9 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 the Supported Command, the End User (who will occupy the facility), NAVFAC (Echelon III and IV), the Navy Region/Installation, 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.

1.9.1 Formal Partnering

Provide and host the Partnering sessions with key personnel of the Project

Team, including Contractor personnel and Government personnel. Pay all costs associated with the Partnering effort including the Facilitator, the meeting room, and other incidental items. In exception, participants shall bear their own costs for meals, lodging, and transportation associated with the Partnering sessions.

Before a Partnering session, coordinate with the Facilitator all requirements for incidental items (such as audio-visual equipment, easels, flipchart paper, colored markers, note paper, pens/pencils, colored flash cards, etc.), and have these items available at the Partnering session. Provide copies of documents for distribution to all attendees.

The Facilitator shall be experienced in conducting Partnering Workshops, and shall be acceptable to both the Government and the Contractor. The Facilitator is responsible for leading the team in a timely manner and making sure that issues are identified and resolved. A list of Partnering Facilitators is available from the Contracting Officer.

- a. The Initial Partnering Session shall be a duration of one day minimum. It shall be located at a place off the construction site, as agreed to by the Contracting Officer and the Contractor. It may take place concurrently with the Pre-Construction Meeting.
- b. The Follow-on Partnering Session(s) generally last a half day or less. Schedule them at 3 to six month intervals, or when needed. Participants are encouraged to utilize electronic means to expedite meetings. Meetings may be held at a location off-Base, at the project site, or in a Government Facility on Base. Follow-on meetings may be held concurrently with other scheduled meetings. Attendees need only be those required to resolve current issues. Recommend using the same Facilitator from the Initial Partnering session to achieve best results and for continuity.

1.10 AVAILABILITY OF CADD DRAWING FILES

After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawing files will only be made available to the Contractor for use in preparation of construction data related to the referenced contract subject to the following terms and conditions. Request specific drawing numbers of files required; the entire set of drawing files will not be provided.

Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding

the accuracy or completeness of the electronic CADD files, nor does it make representation to the compatibility of these files with the Contractors hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished CADD files, the signed and sealed construction documents shall govern. The Contractor is responsible for determining if any conflict exists. Use of these CADD files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

1.11 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, 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 address 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 17.00 20

NETWORK ANALYSIS SCHEDULES (NAS)

08/10

PART 1 GENERAL

1.1 DESCRIPTION

The Contractor is responsible for scheduling procurement, Contractor quality control and construction, acceptance testing and training. Refer to Specification Section 01 33 00 SUBMITTAL PROCEDURES to determine if any items require Government approval prior to construction; If any are required, that submittal review time shall be included in the schedule.

The schedule is a tool to manage the project, both for Contractor and Government activities. It will also be used to report progress and evaluate time extensions. If cost-loaded, it will provide the basis for progress payments.

The Contractor shall use the Critical Path Method (CPM) and the Precedence Diagram Method (PDM) to satisfy time and cost applications. For consistency, when scheduling software terminology is used in this specification, the terms in Primavera's scheduling programs are used.

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval action is required. Submit the following in accordance with Section 01 33 00.

SD-01 Preconstruction Submittals

Qualifications; G

Baseline Network Analysis Schedule (NAS); G

SD-07 Certificates

Monthly Network Analysis Schedule Update; G

SD-11 Closeout Submittals

As-Built Schedule; G

1.3 SCHEDULE ACCEPTANCE PRIOR TO START OF WORK

The Contracting Officer and Contractor shall participate in a preliminary meeting(s) to discuss the proposed schedule and requirements of this section prior to the Contractor preparing the Project Baseline Schedule.

Government review comments on the Contractor's schedule(s) shall not relieve the Contractor from compliance with requirements of the Contract Documents.

Only bonds shall be paid prior to acceptance of the Baseline Network Analysis Schedule (NAS).

The acceptance of a Baseline NAS is a condition precedent to:

1. The Contractor starting work on the demolition or construction stage(s) of the contract.
2. Processing Contractor's pay request(s) for construction activities/items of work.
3. Review of any schedule updates.

Submittal of the Baseline Network Analysis Schedule, and subsequent schedule updates, shall be understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor's plan on how the work shall be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced (as-built logic).

1.4 SOFTWARE

Project schedules must be prepared and maintained using Primavera P3, Primavera SureTrak, or Primavera P6. Save files in Concentric P3 or P6 file format, compatible with the Governments version of the scheduling program. Importing data into P3/SureTrak/P6 using data conversion techniques or third party software will be cause for rejection of the submitted schedule.

1.5 QUALIFICATIONS

The designated Scheduler for the project shall have prepared and maintained at least 3 previous schedules of similar size and complexity of this contract using Primavera P3, Primavera SureTrak, or Primavera P6. A resume outlining the qualifications of the Scheduler shall be submitted for acceptance to the Contracting Officer. Payment will not be processed until an acceptable Scheduler is provided.

1.6 NETWORK SYSTEM FORMAT

The system shall include time scaled logic diagrams and specified reports.

1.6.1 Diagrams

Provide Time-scaled Logic Diagram printed in color on ANSI D size sheets. The diagram shall clearly show activities on the critical path. Include the following information for each activity:

- a. Activity ID
- b. Activity Description
- c. Original Duration in Work Days
- d. Remaining duration
- e. Percent Complete
- f. Early Start Date
- g. Early Finish Date

h. Total Float

1.6.2 Schedule Activity Properties and Level of Detail

The NAS shall identify all Government, Construction Quality Management (CQM), Construction activities planned for the project and all other activities that could impact project completion if delayed. Separate activities shall be created for each Phase, Area, Floor Level and Location the activity is occurring. Activity categories included in the schedule are specified below.

With the exception of the Contract Award and Contract Completion Date (CCD) milestone activities, no activity shall be open-ended; each activity shall have predecessor and successor ties. Once an activity exists on the schedule it may not be deleted or renamed to change the scope of the activity and shall not be removed from the schedule logic without approval from the Contracting Officer. The ID number for a deleted activity shall not be re-used for another activity. No more than 20 percent of the activities shall be critical or near critical. Critical is defined as having zero days of Total Float. "Near Critical" is defined as having Total Float of 1 to 14 days. Contractor activities shall be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

1.6.2.1 Activity Categories

Include separate section with all equipment and systems start up, TAB and Commissioning items.

- a. Procurement Activities: Examples of procurement activities include, but are not limited to; Material/equipment submittal preparation, submittal and approval of material/equipment; material/equipment fabrication and delivery, and material/equipment on-site. As a minimum, separate procurement activities will be provided for critical items, long lead items, items requiring government approval and material/equipment procurement for which payment will be requested in advance of installation. The Contractor shall show each delivery with relationship tie to the Construction Activity specifically for the delivery.
- b. Government Activities: Government and other agency activities that could impact progress shall be clearly identified. Government activities include, but are not limited to; Government approved submittal reviews, Government conducted inspections/tests, environmental permit approvals by State regulators, utility outages, Design Start, Construction Start, (including Design/Construction Start for each Fast-Track Phase, and delivery of Government Furnished Material/Equipment.
- c. Quality Management (QM) Activities: CQM Activities shall identify the Preparatory Phase and Initial Phase for each Definable Feature of Work identified in the Contractor's Quality Control Plan. These activities shall be added to each Three-Week Look Ahead Schedule referenced in the paragraph entitled "THREE-WEEK LOOK AHEAD SCHEDULE" and will also be included in each monthly update. The Follow-up Phase will be represented by the Construction Activities in the Baseline Schedule and in the schedule updates.
- d. Construction Activities: No on-site construction activity shall have a duration in excess of 20 working days. Separate construction activities

shall be created for each Phase, Area, Floor Level and Location the activity is occurring. Contractor activities will be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days, unless otherwise defined in this contract.

- e. Turnover and Closeout Activities: Include a separate section with all items on the NAVFAC Red Zone Checklist/POAM that are applicable to this project. The checklist will be provided at the Preconstruction Meeting. As a minimum, this will include all testing, specialized inspection activities, Pre-Final inspection, Punch List Completion, Final Inspection and Acceptance. Add a milestone for the Facility Turnover Planning Meeting at approximately 75 percent construction contract completion or three to six months prior to BOD, whichever is sooner.

1.6.2.2 Contract Milestones and Constraints

- a. Project Start Date Milestones: The Contractor shall include as the first activity on the schedule a start milestone titled "Contract Award", which shall have a Mandatory Start constraint equal to the Contract Award Date.
- b. Projected Completion Milestone: The Contractor shall include an unconstrained finish milestone on the schedule titled "Projected Completion". Projected Completion is defined as the point in time the Government would consider the project complete and ready for its intended use. This milestone shall have the Contract Completion (CCD) milestone as its only successor.
- c. Contract Completion Date (CCD) Milestone: The Contractor shall include as the last activity on the schedule a finish milestone titled "Contract Completion (CCD)", which shall have a Mandatory Finish constraint equal to the current Contract Completion Date. Calculation of schedule updates shall be such that if the finish of the "Projected Completion" milestone falls after the contract completion date, then negative float will be calculated on the longest path and if the finish of the "Projected Completion" milestone falls before the contract completion date, the float calculation shall reflect positive float on the longest path. The only predecessor to the Contract Completion Date Milestone shall be the Projected Completion milestone.

1.6.2.3 Activity Code

At a minimum, the Contractor shall establish activity codes identified in this specification and 3 additional activity codes identified by the Contracting Officer. Once established, activity codes and values cannot be changed without approval by the Contracting Officer.

- a. Phase: All activities shall be assigned a 4-digit code value based on the contract phase it occurs in.
- b. Area Code: All activities shall be assigned an area code value identifying the Area in which the activity occurs. Activities shall not belong to more than one area. Area is defined as a distinct space, function or activity category; such as, separate structure(s), sitework, project summary, construction quality management, material/equipment procurement, etc.
- c. Work Item: All activities in the project schedule shall be assigned a

4-digit Work Item code value. Examples of Work Item code values include but are not limited to water lines, drain lines, building pad and foundation, slab on grade, walls and columns, suspended slab, roof structure, roofing, exterior finish systems, interior rough-in, and finishes, etc.

- d. Location 1: Assign a 4-digit Location 1 code value to activities associated with multistory structures. Code values are used to identify the floor level where an activity is occurring.
- e. Location 2: Assign a 4-digit Location 2 code value to all activities to identify the location within an Area, Work Item or Building Level that an activity is occurring.
- f. Responsibility Code: All activities in the project schedule shall be identified with the party responsible for completing the task. Activities shall not belong to more than one responsible party.

1.6.2.4 Anticipated Weather Delays

The Contractor shall use the National Oceanic and Atmospheric Administration's (NOAA) historical monthly averages for the NOAA location closest to the project site as the basis for establishing a "Weather Calendar" showing the number of anticipated non-workdays for each month due to adverse weather, Saturdays, Sundays and all Federal Holidays as non-work days.

Assign the Weather Calendar to any activity that could be impacted by adverse weather. The Contracting Officer will issue a modification in accordance with the contract clauses, giving the Contractor a time extension for the difference of days between the anticipated and actual adverse weather delay if the number of actual adverse weather delay days exceeds the number of days anticipated for the month in which the delay occurs and the adverse weather delayed activities critical to contract completion. A lost workday due to weather conditions is defined as a day in which the Contractor cannot work at least 50 percent of the day on the impacted activity.

1.6.2.5 Cost Loading

- a. Cost Loading Activities: Material and Equipment Costs for which payment will be requested in advance of installation shall be assigned to their respective procurement activity (i.e., the material/equipment on-site activity). All other construction costs shall be assigned to their respective Construction Activities. The value of inspection/testing activities will not be less than 10 percent of the total costs for Procurement and Construction Activities. Evenly disperse overhead and profit to each activity over the duration of the project.
- b. Quantities and Units of Measure: Each cost loaded activity shall have a detailed quantity breakdown and unit of measure.

1.6.3 Schedule Software Settings and Restrictions

- a. Activity Constraints: Date/time constraint(s), other than those required by the contract, will not be allowed unless accepted by the Contracting Officer. Identify any constraints proposed and provide an explanation for the purpose of the constraint in the Narrative Report.

- b. Default Progress Data Disallowed: Actual Start and Actual Finish dates on the CPM schedule shall match the dates on the Contractor Quality Control and Production Reports.
- c. Software Settings: Schedule calculations and Out-of-Sequence progress (if applicable) shall be handled through Retained Logic, not Progress Override. All activity durations and float values will be shown in days. Activity progress will be shown using Remaining Duration. Default activity type will be set to "Task". The project "Must Finish By" date shall be left blank.

1.6.4 Required Tabular Reports

The following reports shall be included with the schedule submittal:

- a. Log Report: Listing of all changes made between the previous schedule and current updated schedule.
- b. Narrative Report: Identify and justify; 1) Progress made in each area of the project; 2) Critical Path; 3) Date/time constraint(s), other than those required by the contract 3) Changes in the following; added or deleted activities, original and remaining durations for activities that have not started, logic, milestones, planned sequence of operations, critical path, and cost loading; 4) Any decrease in previously reported activity Earned Amount; 5) Pending items and status thereof, including permits, changes orders, and time extensions; 6) Status of Contract Completion Date and interim milestones; 7) Current and anticipated delays (describe cause of delay and corrective actions(s)); and 8) Description of current and future schedule problem areas. Each entry in the narrative report will cite the respective Activity ID and Activity Description, the date and reason for the change, and description of the change.
- c. Earned Value Report: Listing all activities having a budget amount cost loaded. Compilation of total earnings on the project from notice to proceed to current progress payment request. Group and sort activities as directed by the Contracting Officer. Show current budget, previous physical percent complete, to-date physical percent complete, previous earned value, to-date earned value and cost to complete on the report for each activity:
- d. Schedule Variance Control (SVC) Diagram: With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates and 2) Earned Value to-date. Revise Cash Flow S-Curves when the contract is modified, or as directed by the Contracting Officer.

1.7 SUBMISSION AND ACCEPTANCE

1.7.1 Monthly Network Analysis Updates

Contractor and Government representatives shall meet at monthly intervals to review and agree on the information presented in the updated project schedule. The submission of an acceptable, updated schedule to the Government is a condition precedent to the processing of the Contractor's pay request. If a Schedule of Prices is the basis for progress payments, it shall be consistent with the logic and activity breakdowns on the progress schedule. If progress payments are based on a cost-loaded schedule, the Contractor and Government shall agree on percentage of

payment for each activity progressed during the update period.

Provide the following with each Schedule submittal:

- a. Time Scaled Logic Diagram.
- b. Reports listed in paragraph entitled "Required Tabular Reports."
- c. Data disks containing the project schedule. Include the back-up native .prx/current mandated schedule program files.

1.7.2 As-Built Schedule

As a condition precedent to the release of retention and making final payment, submit an "As-Built Schedule," as the last schedule update showing all activities at 100 percent completion. This schedule shall reflect the exact manner in which the project was actually constructed.

1.8 CONTRACT MODIFICATION

Submit a Time Impact Analysis with each cost and time proposal for a proposed change. Time Impact Analysis (TIA) shall illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float, and extends the Projected Finish beyond the Contract Completion Date.

- a. Each TIA shall be in both narrative and schedule form demonstrating the delay impact. The TIA shall identify the predecessors to the new activities and demonstrate the impacts to successor activities. The Contractor shall run the schedule calculations and submit the impacted schedule with the proposal or claim.
- b. The TIA schedule submitted with the proposal shall show all activity progress as of the date of the proposal. If the impact to the schedule occurs prior to the proposal submission, the TIA schedule shall be updated to show all activity progress as of the time of the impact. If the proposed change does not impact the CCD, no TIA shall be required.
- c. Submit Data disks containing the TIA schedule. Include the back-up native .prx/current mandated schedule program files.
- d. Unless the Contracting Officer requests otherwise, only conformed contract modifications shall be added into the Project NAS.

1.9 PROJECT FLOAT

Project Float is the length of time between the Contractor's Projected Finish Milestone and the Contract Completion Date Milestone. Project Float available in the schedule, at any time shall not be for the exclusive use of either the Government or the Contractor.

1.10 THREE-WEEK LOOK AHEAD SCHEDULE

The Contractor shall prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Project Network Analysis Schedule. The work plans shall be keyed to NAS activity numbers and updated each week to show the planned work for the current and following two-week period. Additionally, include upcoming

outages, closures, preparatory meetings, and initial meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. The detail work plans are to be bar chart type schedules, maintained separately from the Project NAS on an electronic spreadsheet program and printed on 8 ½ by 11 sheets as directed by the Contracting Officer. Activities shall not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work. Three hard copies and one electronic file of the 3-Week Look Ahead Schedule shall be delivered to the Contracting Officer no later than 8 a.m. each Monday and reviewed during the weekly CQC Coordination Meeting.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

05/11

PART 1 GENERAL

1.1 SUMMARY

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2 DEFINITIONS

1.2.1 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 start of construction (work). issuance of contract notice to proceed.or commencing work on site.or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices or Earned Value Report

Health and safety plan

Work plan

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 unfabricated 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.

Design submittals, design substantiation submittals and extensions of design submittals.

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 accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

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 document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS) 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

state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

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 maintain and install 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 or control system.

SD-11 Closeout Submittals

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

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 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

Submittal Register; G

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical

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

1.5 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.5.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward to the Contracting Officer submittals required in the technical sections of this specification, including shop drawings, product data, samples, training materials (plan, syllabus, etc.) and O&Ms. Forward one copy of the transmittal form for all submittals to the Resident Officer in Charge of Construction.

The Architect-Engineer for this project will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.5.1.1 eOMSI Data

The Architect-Engineer for this project will review and approve for the Contracting Officer eOMSI Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver eOMSI Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such eOMSI Data are applicable.

1.6 PREPARATION

1.6.1 General Submittal Procedure Requirements

Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections. Submit according to pre-determined system as selected from one of the following formats:

a. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.

1) Contracting Officer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

b. Submit electronic submittals via email as PDF electronic files.

1) Contracting Officer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

1.6.2 Electronic Submittals

Identify and incorporate information in each electronic submittal file as

follows:

a. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

b. Name file with submittal number or other unique identifier, including revision identifier.

1) File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

c. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Contracting Officer.

d. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to Government.

1.6.3 Transmittal Form

Transmit each submittal, except sample installations and sample panels to office of approving authority. 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. Process transmittal forms to record actions regarding samples.

1.6.4 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 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.

h. Product identification and location in project.

1.6.5 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 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. Contractors may use their own number system. 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.

Submit drawings PDF format.

1.6.6 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.

1.6.7 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 8 1/2 by 11 inches.
- c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 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 clean up 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.

1.6.8 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.

1.6.9 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.

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

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.6.11 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

1.7 QUANTITY OF SUBMITTALS

Submittals shall be submitted electronically. Where electronic submittals are not possible or otherwise required by Specifications, provide the following quantities.

1.7.1 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.

1.8 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.8.1 Considering Variations

Discussion with Contracting Officer prior to submission, after consulting with the DOR, 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).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.8.2 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 DOR's written analysis and approval. If lower cost is a benefit, 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.

1.8.3 Warranting that Variations are Compatible

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

1.8.4 Review Schedule is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.9 SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.00 20 QUALITY CONTROL.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicate approving authority for each submittal.

1.9.1 Use of Submittal Register

Submit submittal register as an electronic database, using submittals management program furnished to Contractor. Submit 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 database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.9.2 Contractor Use of Submittal Register

Update the following fields in program utilized by Contractor with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.9.3 Approving Authority Use of Submittal Register

Update the following fields in program utilized by Contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.9.4 Action Codes

Entries for columns (j) and (o), are to be used as follows (others may be prescribed by Transmittal Form):

1.9.4.1 Government Review Action Codes

"A" - "Approved as submitted"; "Completed"

"B" - "Approved, except as noted on drawings"; "Completed"

"C" - "Approved, except as noted on drawings; resubmission required"; "Resubmit"

"D" - "Returned by separate correspondence"; "Completed"

"E" - "Disapproved (See attached)"; "Resubmit"

"F" - "Receipt acknowledged"; "Completed"

"G" - "Other (Specify)"; "Resubmit"

"X" - "Receipt acknowledged, does not comply with contract requirements"; "Resubmit"

1.9.4.2 Contractor Action Codes

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.10 SCHEDULING

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. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."
- 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."
- e. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 10 working days

for submittals for QC Manager approval and 20 working days for submittals for Contracting Officer approval. Period of review for submittals with Contracting Officer approval begins when Government receives submittal from QC organization.

- f. For submittals requiring review by fire protection engineer, allow review period, beginning when Government receives submittal from QC organization, of 30 working days for return of submittal to the Contractor.
 - g. Period of review for each resubmittal is the same as for initial submittal.
- 1.10.1 Reviewing, Certifying, Approving Authority

The QC organization is responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is QC Manager unless otherwise specified for specific submittal. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item, indicates Contracting Officer is approving authority for that submittal item.

1.10.2 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of work. Submit at the same time components of definable feature interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.10.3 QC Organization Responsibilities

- a. Note date on which submittal was received from Contractor on each submittal.
- b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.
- c. Review submittals for conformance with project design concepts and compliance with contract documents.
- d. Act on submittals, determining appropriate action based on QC organization's review of submittal.
 - (1) When QC Manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Approved Submittals," of the section."
 - (2) When Contracting Officer is approving authority or when variation has been proposed, forward submittal to Government with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of

submittal determines appropriate action.

- e. Ensure that material is clearly legible.
- f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is Contracting Officer, QC organization will certify submittals forwarded to Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____"
(Signature)

(2) When approving authority is QC Manager, QC Manager will use the following approval statement when returning submittals to Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"
(Signature)

- g. Sign certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. Stamped signatures are not acceptable.
- h. Update submittal register as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by Contracting Officer.
- i. Retain a copy of approved submittals at project site, including Contractor's copy of approved samples.

1.11 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

- a. Note date on which submittal was received from QC Manager.
- b. Review submittals for approval within scheduling period specified and

only for conformance with project design concepts and compliance with contract documents.

- c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date submittals.

1.11.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" "or approved, except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
- c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.
- d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.12 DISAPPROVED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.13 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory. design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work.

After submittals have been approved or accepted 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.

1.14 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 to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

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, 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. Contractor to replace such materials or equipment to meet contract requirements.

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		MAILED TO CONTR/ DATE RCD FRM APPR AUTH
		01 11 00	SD-01 Preconstruction Submittals														
			Utility Outage Requests	1.8.1													
			Utility Connection Requests	1.8.1													
			Borrow Permits	1.8.2													
			Excavation Permits	1.8.2													
			Welding Permits	1.8.2													
			SD-07 Certificates														
			Energy Performance Rating	1.5													
		01 14 00	SD-01 Preconstruction Submittals														
			List of Contact Personnel	1.3.1.1	G												
		01 20 00.00 20	SD-01 Preconstruction Submittals														
			Earned Value Report	1.3	G												
		01 30 00	SD-01 Preconstruction Submittals														
			View location map	1.2	G												
			Progress and completion pictures	1.3	G												
		01 32 17.00 20	SD-01 Preconstruction Submittals														
			Qualifications	1.5	G												
			Baseline Network Analysis	1.3	G												
			Schedule														
			SD-07 Certificates														
			Monthly Network Analysis	1.7.1	G												
			SD-11 Closeout Submittals														
			As-Built Schedule	1.7.2	G												
		01 33 00	SD-01 Preconstruction Submittals														
			Submittal Register	1.9	G												
		01 33 29	SD-01 Preconstruction Submittals														

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																		(a)
		01 33 29	Preliminary Sustainability Notebook	1.5.2.1	G													
			Preliminary High Performance and Sustainable Building Checklist	1.5.2.1														
			SD-11 Closeout Submittals															
			Final Sustainability Notebook	1.5.2.1	G													
			Final High Performance and Sustainable Building Checklist	1.5.2.1	G													
			Amended Final Sustainability Notebook	1.5.2.1	G													
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.7	G													
			Activity Hazard Analysis (AHA)	1.8	G													
			Crane Critical Lift Plan	1.7.1	G													
			Crane Operators	1.6.1.3	G													
			SD-06 Test Reports															
			Notifications and Reports	1.12														
			Accident Reports	1.12.2	G													
			Crane Reports	1.12.3														
			SD-07 Certificates															
			Hot work permit	1.9														
			License Certificates	1.14														
			Contractor Safety Self-Evaluation Checklist	1.4	G													
			Certificate of Compliance	1.12.4														
		01 45 00.00 20	SD-01 Preconstruction Submittals															

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 45 00.00 20	Construction Quality Control (QC) Plan	1.6.1	G												
			Indoor Air Quality (IAQ) Management Plan	1.17	G												
		01 45 35	SD-06 Test Reports														
			Special Inspection Reports	1.9													
			SD-07 Certificates														
			Special Inspector	1.6	G												
			Quality Control Plan	1.5	G												
			Contractor Statement of Responsibility	1.7													
			Testing Agency Qualifications	1.8													
		01 50 00	SD-01 Preconstruction Submittals														
			Construction site plan	1.3	G												
			Traffic control plan	3.4.1	G												
		01 57 19.00 20	SD-01 Preconstruction Submittals														
			Solid Waste Management Permit	3.4	G												
			Dirt and Dust Control Plan	3.14.1	G												
			Preconstruction Survey	1.5.1	G												
			Environmental Management Plan	1.5.3	G												
			Solid Waste Management Plan and Permit	3.4	G												
			Regulatory Notifications	1.5.2	G												
			Storm Water Pollution Prevention Plan	3.2.1.2	G												

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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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19.00 20	Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities)		G												
			Contractor Hazardous Material Inventory Log	3.6	G												
			ECATTS certificate of completion	1.4.1	G												
			SD-06 Test Reports														
			Laboratory Analysis	3.13.2.2													
			Disposal Requirements	3.15.2													
			Storm Water Inspection Reports for General Permit														
			Contractor 40 CFR employee training records	1.5.5													
			Solid Waste Management Report	3.4.1	G												
			SD-11 Closeout Submittals														
			Storm Water Pollution Prevention Plan compliance notebook		G												
			Waste Determination Documentation	3.5													
			Disposal Documentation for Hazardous and Regulated Waste	3.6.1													
			Contractor 40 CFR Employee Training Records	1.5.5													
			Solid Waste Management Report	3.4.1													

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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
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19.00 20	Contractor Hazardous Material Inventory Log	3.6	G												
			Hazardous Waste/Debris Management	3.13.2													
			Regulatory Notifications	1.5.2													
		01 57 19.01 20	SD-01 Preconstruction Submittals														
			Excavation Permits		G												
			Dirt and Control Plan		G												
			Storage Form		G												
			PSCAA Non-Road Notification Form		G												
			Notice of Construction		G												
			Contractor's Operation and Maintenance (O & M) Plan														
			Project Report														
			Waste Originator Training Certification		G												
			SD-03 Product Data														
			HVAC&R equipment	1.4.1.4.4	G												
		01 58 00	SD-02 Shop Drawings														
			Preliminary Drawing Indicating Layout and Text Content	1.3.1	G												
			Sign Legend Orders		G												
		01 78 00	SD-03 Product Data														
			As-Built Record of Equipment and Materials	1.3.2													

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		MAILED TO CONTR/ DATE RCD FRM APPR AUTH
		01 78 00	Warranty Management Plan	1.7.1													
			Warranty Tags	1.7.4													
			Final Cleaning	1.11													
			Spare Parts Data	1.4													
			SD-07 Certificates														
			Certification of EPA Designated Items	1.6													
			SD-08 Manufacturer's Instructions														
			Preventative Maintenance	1.5													
			Condition Monitoring (Predictive Testing)	1.5													
			Inspection	1.5													
			Instructions	1.7.1													
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	1.10													
			SD-11 Closeout Submittals														
			Record Drawings	1.3.1													
			Certification of EPA Designated Items	1.6	G												
			Interim Form DD1354	1.12	G												
			Checklist for Form DD1354	1.12	G												
			NAVFAC Sustainable & Energy Data Record Card	1.9	G												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		MAILED TO CONTR/ DATE RCD FRM APPR AUTH	
																		(a)
		01 78 23.33	SD-10 Operation and Maintenance Data															
			System Instructions	2.1.1	G													
			Updated Operations and Maintenance Manual LP-Gas Storage, Vaporization and Distribution System SWOSU Fire Fighter Trainer (Building 510)	3.5	G													
		01 78 24.00 20	SD-10 Operation and Maintenance Data															
			Training Plan	3.2.1	G A/E													
			Training Outline	3.2.3	G A/E													
			Training Content	3.2.2	G A/E													
			SD-11 Closeout Submittals															
			eOMSI, Progress Submittal	1.4.1	G A/E													
			eOMSI, Prefinal Submittal	1.4.2	G A/E													
			eOMSI, Final Submittal	1.4.3	G A/E													
			Training Video Recording	3.2.4	G A/E													
			Validation of Training Completion	3.2.6	G A/E													
		01 91 00.00 40	SD-01 Preconstruction Submittals															
			Start up and Contractor Test Plan		G A/E													
			Start up and Contractor Test Schedule		G A/E													
			Commissioning Schedule		G A/E													
			SD-06 Test Reports															

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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
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 91 00.00 40	Functional Performance Testing Results	3.3.5	G												
			Seasonal Testing Report		G												
			Deficiency Report and Resolution Record		G												
			SD-10 Operation and Maintenance Data														
			Operations and Maintenance Manuals	3.6	G A/E												
			Training Plan	3.6	G A/E												
			Operations and Maintenance Database		G A/E												
			SD-11 Closeout Submittals														
			Warranty	3.1	G A/E												
		02 41 00	SD-07 Certificates														
			Demolition Plan	1.2.1	G												
			Notification	1.7	G												
		03 01 30.71	SD-05 Design Data														
			Job mix formula	1.4.1.1													
			SD-06 Test Reports														
			aggregate	2.1.2													
			Epoxy resin binder	2.1.1.1													
			Epoxy grout	2.1.1.2													
			SD-08 Manufacturer's Instructions														
			Epoxy	2.1.1													
		03 30 00	SD-01 Preconstruction Submittals														

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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
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Concrete Curing Plan	1.6.3.1													
			Quality Control Plan	1.6.5													
			Quality Control Personnel Certifications	1.6.6													
			Quality Control Organizational Chart	1.6.6													
			Laboratory Accreditation	1.6.8													
			SD-02 Shop Drawings														
			Reinforcing steel	1.6.2.1													
			SD-03 Product Data														
			Joint sealants	2.4.7													
			Joint filler	2.4.6													
			Cementitious Materials	2.4.1													
			Concrete Curing Materials	2.3.3													
			Reinforcement	2.5													
			Admixtures	2.4.5													
			SD-05 Design Data														
			mix design	2.3.1	G												
			SD-06 Test Reports														
			Concrete mix design	1.6.1.1	G												
			Fly ash	1.6.4.1													
			Pozzolan	1.6.4.1													
			Aggregates	2.4.3													
			Compressive strength tests	3.12.2.3	G												
			Unit weight of structural concrete	3.12.2.5													
			Air Content	3.12.2.4													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Slump Tests	3.12.2.1													
			Water	2.4.2													
			SD-07 Certificates														
			Reinforcing Bars	2.5.1													
			Material Safety Data Sheets	1.6.3.2													
			Field Testing Technician and Testing Agency	1.6.6.2													
			SD-08 Manufacturer's Instructions														
			Curing Compound	2.3.3													
		05 12 00	SD-01 Preconstruction Submittals														
			Erection Drawings	1.3.1.1	G												
			SD-02 Shop Drawings														
			Fabrication drawings	1.3.2	G												
			SD-03 Product Data														
			Welding electrodes and rods	2.4.1													
			Direct Tension Indicator Washers	2.3.2.3													
			Non-Shrink Grout	2.4.2													
			Tension control bolts	2.3.3													
			SD-06 Test Reports														
			Bolts, nuts, and washers	2.3													
			Weld Inspection Reports	3.6.1.2													
			Direct Tension Indicator Washer Inspection Reports	3.6.2.1													
			SD-07 Certificates														
			Steel	2.2													
			Bolts, nuts, and washers	2.3													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 12 00	Galvanizing	2.5													
			Welding procedures and qualifications	1.3.3.1													
			Welding electrodes and rods	2.4.1													
		05 50 13	SD-02 Shop Drawings														
			structural steel door frames		G												
			Safety Chains	2.5	G												
			SD-03 Product Data														
			Safety chains	2.5													
		05 53 14	SD-02 Shop Drawings														
			Fabrication and erection drawings		G												
			Anchor details and		G												
			Welding of Structural Steel														
			Structural Steel Welding Repairs		G												
			SD-06 Test Reports														
			Tests, Inspections, and Verifications														
			SD-07 Certificates														
			Welding Qualifications														
		06 10 00	SD-02 Shop Drawings														
			Nailing Strips	3.1.1.1	G												
			SD-03 Product Data														
			Fire-retardant treatment	1.8													
			Preservative Treatment	1.7													
			Certificates of Grade	1.9.1													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 10 00	Adhesives	2.2.3													
			SD-06 Test Reports														
			Preservative-treated	1.4.2													
		07 22 00	SD-02 Shop Drawings														
			Wood nailers	2.4													
			Tapered roof insulation	2.1.3	G												
			SD-03 Product Data														
			Fasteners	2.3	G												
			Insulation	2.1	G												
			SD-06 Test Reports														
			Flame spread and smoke developed ratings	1.5.1													
			SD-07 Certificates														
			qualifications	1.4													
			SD-08 Manufacturer's Instructions														
			fasteners	2.3													
			insulation	2.1													
		07 52 00	SD-02 Shop Drawings														
			Roof repair plan	1.4.7	G												
			SD-03 Product Data														
			Modified Bitumen Sheets	2.1	G												
			Primer	2.5	G												
			Torch-Applied Membrane	2.3	G												
			Adhesive														
			Fasteners And Plates	2.6	G												
			Non-Shrink Grout	2.9.7	G												

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		07 52 00	Warranty	1.9	G												
			SD-07 Certificates														
			Qualification of Manufacturer	1.4.1													
			Qualification of Applicator	1.4.2													
			Qualification of Inspector	1.4.3	G												
			Qualifications for Manufacturer's Technical Representative	1.4.4													
			SD-08 Manufacturer's Instructions														
			Modified Bitumen Membrane Application	3.4.3	G												
			Blister Repair	3.3.2													
			Open Lap/Seam Repair	3.3.1													
			Flashing	3.4.4	G												
			Primer	2.5													
			Fasteners	2.6.1													
			SD-11 Closeout Submittals														
			Warranty	1.9													
			Information Card	3.9													
		07 53 23	SD-02 Shop Drawings														
			Roof Plan Drawing	1.3.1													
			Slopes and Drain Locations	1.3.1													
			SD-03 Product Data														
			Cement	2.2													
			EPDM Sheet	2.1.1	G												
			Seam Tape	2.1.2													
			Bonding Adhesive	2.1.4													

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		07 53 23	Lap Splice Adhesive	2.1.3													
			Water Cutoff Mastic/Water Block	2.1.6													
			Lap Cleaner, Lap Sealant, and Edge Treatment	2.1.5													
			Flashings	3.3													
			Application Method	3.2.3													
			Fasteners and Plates	2.1.7													
			Roof Insulation														
			warranty	1.8	G												
			SD-07 Certificates														
			Qualification of Manufacturer	1.4.1													
			Qualification of Applicator	1.4.2													
			Fire Resistance		G												
			SD-08 Manufacturer's Instructions														
			Application	3.2	G												
			Adhesive Seams / Lap Splices	3.2.4													
			Primer														
			Fasteners														
			Cold Weather	1.6	G												
			SD-11 Closeout Submittals														
			Warranty	1.8													
			Information Card	3.9													
			Instructions To Government	3.8													
			Personnel														
		07 56 00	SD-03 Product Data														
			Construction Grade Caulk	2.3.1	G												

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		07 56 00	Basecoat and Intermediate Coatings	2.3.2	G												
			Finish Coat	2.3.3	G												
			Reinforcing Fabric	2.3.5	G												
			Cant Strips	2.3.7	G												
			Corrosion Resistant Primer	2.3.8	G												
			Traffic Coating	2.3.9	G												
			Biodegradable Cleaner	2.3.10	G												
			SD-07 Certificates														
			Manufacturer Qualifications	1.5.1	G												
			Installer Qualifications	1.5.2													
			Qualification of Inspector	1.5.7													
			SD-08 Manufacturer's Instructions														
			Manufacturer's written instructions	1.5.1													
			SD-09 Manufacturer's Field Reports														
			Field tests	3.10	G												
			Manufacturer's Inspection	3.10.1.1	G												
		07 60 00	SD-02 Shop Drawings														
			Gravel stops and fascias	3.1.12	G												
			Counterflashing	3.1.10	G												
			Reglets	3.1.11	G												
			Copings	3.1.18	G												
			Drip edge	3.1.13	G												
			flashing at roof penetrations	3.1.15	G												

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		07 60 00	SD-11 Closeout Submittals														
			Quality Control Plan	3.5													
		07 82 00	SD-02 Shop Drawings														
			Refractory panel	2.3	G												
			Anchor bolts	3.1	G												
			SD-03 Product Data														
			refractory panels	2.3	G												
			refractory panels	2.3	G												
			Test Reports	1.3													
		07 84 00	SD-02 Shop Drawings														
			Firestopping Materials	2.1	G												
			SD-06 Test Reports														
			Inspection	3.3	G												
			SD-07 Certificates														
			Inspector Qualifications	1.4.2													
			Firestopping Materials	2.1													
			Installer Qualifications	1.4.1	G												
		07 92 00	SD-03 Product Data														
			Sealants	2.1													
			Primers	2.4													
			Bond breakers	2.5													
			Backstops	2.6													
			SD-07 Certificates														
			Sealant	3.3.6													
		09 67 23.13	SD-02 Shop Drawings														
			Fabrication Drawings	1.4.3													

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		09 67 23.13	SD-03 Product Data														
			Epoxy-Resin Binder/Matrix	2.1.1													
			Cured Epoxy Binder	2.1.2													
			Walnut Shell Aggregate	2.1.3													
			Surface Sealing Coat	2.1.4													
			SD-04 Samples														
			Hardboard	1.4.2													
			SD-05 Design Data														
			Epoxy-Resin Binder/Matrix	2.1.1													
			Cured Epoxy Binder	2.1.2													
			Surface Sealing Coat	2.1.4													
			SD-06 Test Reports														
			Records of Inspection	1.4													
			SD-07 Certificates														
			Listing of Product Installations	1.4.1													
			Epoxy-Resin Binder/Matrix	2.1.1													
			Cured Epoxy Binder	2.1.2													
			Walnut Shell Aggregate	2.1.3													
			Surface Sealing Coat	2.1.4													
		09 90 00	SD-03 Product Data														
			Coating	2.1	G												
			Manufacturer's Technical Data	2.1													
			Sheets														
			SD-04 Samples														
			Coating	2.1	G												
			SD-07 Certificates														

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		09 90 00	Applicator's qualifications	1.3													
			SD-08 Manufacturer's Instructions														
			Manufacturer's Material Safety Data Sheets														
		13 48 00	SD-02 Shop Drawings														
			Bracing	3.1	G												
			Resilient Vibration Isolation Devices	3.4	G												
			Equipment Requirements	2.1	G												
			SD-03 Product Data														
			Bracing	3.1	G												
			Equipment Requirements	2.1	G												
			SD-06 Test Reports														
			Anchor Bolts	3.3	G												
		21 21 02.00 20	SD-02 Shop Drawings														
			Electrical wiring diagrams		G												
			Actuating station	2.7													
			SD-03 Product Data														
			Refrigerated storage tank		G												
			Valves		G												
			Alarm bells		G												
			Pressure relief devices	2.3	G												
			Pipe and fittings	2.2	G												
			Pipe hangers and supports		G												
			Warning signs		G												
			SD-06 Test Reports														

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																		(g)
		21 21 02.00 20	System preliminary tests	1.5.6	G													
			SD-07 Certificates															
			Parts reliability	1.5.2	G													
			Installer qualifications	1.5.1.1	G													
			Test procedures	1.5.3	G													
			Installation personnel	1.5.4	G													
			UL listings or FM approvals	1.5.5	G													
			Contractor's material and test certificate	1.5.7	G													
			Pipe and fittings	2.2	G													
			SD-10 Operation and Maintenance Data															
			As-built Record Drawings	1.3.1														
			Refrigerated storage tank		G													
		22 00 00	SD-03 Product Data															
			Water level Sensors	2.6.5														
			Chemical Feed Pumps	2.4.1	G													
			SD-07 Certificates															
			Materials and Equipment	1.3														
			Bolts	2.1.1														
			SD-10 Operation and Maintenance Data															
			Plumbing System	3.5.1	G													
		23 00 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.5	G													
			SD-03 Product Data															

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		23 00 00	Duct Connectors	2.9.1.1													
			Duct Access Doors	2.9.2	G												
			Manual Balancing Dampers	2.9.3	G												
			Diffusers	2.9.4.1													
			Registers and Grilles	2.9.4.3													
			SD-06 Test Reports														
			Performance Tests	3.11	G												
			SD-08 Manufacturer's Instructions														
			Manufacturer's Installation	3.2													
			Instructions														
			Operation and Maintenance	3.13.2													
			Training														
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	3.13.1	G												
			Manuals														
			Manual Balancing Dampers	2.9.3	G												
		23 01 30.41	SD-01 Preconstruction Submittals														
			Record of Existing Conditions	3.2.1	G												
			Coordination Plan	3.2.2	G												
			NADCA Firm	1.4.1	G												
			NADCA Team Assistants	1.4.1	G												
			NADCA Air System Cleaning	1.4.1	G												
			Specialist (ASCS)														
			NADCA Supervisor Qualifications	1.4.1	G												

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		23 01 30.41	Records of Experience in the Field of HVAC System Cleaning	1.4.2													
			NADCA Work Execution Schedule	1.6.1	G												
			SD-06 Test Reports														
			Testing Procedures Summary	3.7	G												
			Post-Project Report	3.7	G												
		23 05 15	SD-01 Preconstruction Submittals														
			List of qualified permanent service organizations	1.4.3													
			SD-02 Shop Drawings														
			Record Drawings	1.2	G												
			Connection Diagrams	1.2													
			Coordination Drawings	1.2													
			Installation Drawings	3.1													
			SD-03 Product Data														
			Piping Specialties	2.2	G												
			Valves	2.3	G												
			Equipment Foundation Data	1.2													
			Pipe and Fittings	2.1													
			Miscellaneous Materials	2.4													
			Surface Resistance	3.1													
			Shear and Tensile Strengths	3.1													
			Temperature Ratings	3.1													
			SD-06 Test Reports														
			Air Tests	3.1	G												

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		23 05 15	Bending Tests	3.1													
			Flattening Tests	3.1													
			Transverse Guided Weld Bend Tests	3.1													
			Hydrostatic Tests	3.1													
			Valve-Operating Tests	3.1													
			Drainage Tests	3.1													
			Pneumatic Tests	3.1													
			Non-Destructive Tests														
			System Operation Tests	3.1													
			SD-10 Operation and Maintenance Data														
			Records of Existing Conditions	1.2													
			Record of satisfactory field operation	1.4.2													
			Operation and Maintenance Manuals	3.8	G												
		23 05 48.00 40	SD-02 Shop Drawings														
			Installation Drawings	1.2	G												
			SD-03 Product Data														
			Equipment and Performance Data	1.2	G												
			Isolators	2.3	G												
			SD-06 Test Reports														
			Type of Isolator	2.1	G												
			Type of Base	2.1	G												

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		23 05 93	SD-01 Preconstruction Submittals														
			Records of Existing Conditions	1.3	G												
			Records of Existing Conditions	1.3.3	G												
			TAB Firm	1.5.4.1	G												
			TAB team assistants	1.2	G												
			TAB team engineer	1.2	G												
			TAB team field leader	1.2	G												
			SD-02 Shop Drawings														
			TAB Schematic Drawings and Report Forms	1.3.3	G												
			SD-03 Product Data														
			Equipment and Performance Data	1.3	G												
			TAB Related HVAC Submittals	1.5.4.4	G												
			TAB Procedures	1.5.2	G												
			Calibration	1.5.2	G												
			Systems Readiness Check	1.3.3	G												
			TAB Execution	1.5.5	G												
			TAB Verification	1.5.5.3	G												
			SD-06 Test Reports														
			DALT and TAB Work Execution Schedule	3.7	G												
			DALT and TAB Procedures Summary	3.7	G												
			Pre-Final DALT report	1.5.3	G												
			Pre-Final DALT report	1.7.3	G												

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																		(g)
		23 05 93	Pre-Final DALT report	3.3.5	G													
			Final DALT report	1.5.3	G													
			Final DALT report	1.7.3	G													
			Final DALT report	3.3.8	G													
			TAB report	1.5.6.2	G													
			TAB report	3.7	G													
			SD-07 Certificates															
			Independent TAB agency and personnel qualifications	1.5.1	G													
			Independent TAB agency and personnel qualifications	1.5.1	G													
			Advance notice of Pre-Final DALT field work	3.3.2	G													
			Advance Notice of TAB Field Work	3.7	G													
			Completed Pre-TAB Work Checklist	3.7														
			Completed Pre-TAB Work Checklist	3.7														
			TAB Firm	1.5.4.1	G													
			DALT and TAB Submittal and Work Schedule	1.7.1	G													
			DALT and TAB Submittal and Work Schedule	1.7.3	G													
			Pre-field DALT preliminary notification	1.7.3.1	G													

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		23 05 93	Pre-field TAB engineering report	1.7.3.2	G												
			Advanced notice for TAB field work	1.7.3	G												
			Prerequisite HVAC Work Check Out List	1.7.3	G												
		23 07 00	SD-02 Shop Drawings														
			Pipe Insulation Systems	2.3													
			Duct Insulation Systems	3.3													
			SD-03 Product Data														
			Pipe Insulation Systems	2.3	G												
			Duct Insulation Systems	3.3	G												
			SD-04 Samples														
			Thermal Insulation	2.2.1.3	G												
			SD-08 Manufacturer's Instructions														
			Pipe Insulation Systems	2.3	G												
			Duct Insulation Systems	3.3	G												
		23 09 23.13 20	SD-02 Shop Drawings														
			Control system drawings title sheet	1.4.1.1	G												
			List of I/O Points	1.4.1.2	G												
			Control System Components List	1.4.1.3	G												
			Control system schematics	1.4.1.4	G												
			HVAC Equipment Electrical	1.4.1.5	G												
			Ladder diagrams														
			Component wiring diagrams	1.4.1.6	G												
			Terminal strip diagrams	1.4.1.7	G												

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		23 09 23.13 20	BACnet communication architecture schematic	1.4.1.8	G												
			SD-03 Product Data														
			Direct Digital Controllers	2.1.1	G												
			BACnet Protocol Analyzer	2.1.5	G												
			BACnet Operator Workstation	2.1.3.3	G												
			DDC Software														
			Sensors and Input Hardware	2.2	G												
			Output Hardware	2.3	G												
			Surge and transient protection	2.4.2	G												
			Indicators	2.5	G												
			SD-05 Design Data														
			Performance Verification Testing Plan	3.4.2	G												
			Pre-Performance Verification Testing Checklist	3.4.4	G												
			SD-06 Test Reports														
			Performance Verification Testing Report	3.4.11	G												
			SD-09 Manufacturer's Field Reports														
			Pre-PVT Checklist	3.4.1	G												
			SD-10 Operation and Maintenance Data														
			BACnet Direct Digital Control Systems	1.4	G												

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		23 09 23.13 20	Controls System Operators Manuals	3.3	G												
			SD-11 Closeout Submittals														
			Training documentation	3.5.1	G												
		23 11 25	SD-02 Shop Drawings														
			Gas Piping System	1.5.2	G												
			Gas Piping System	2.2	G												
			Gas Piping System	3.3	G												
			SD-03 Product Data														
			Pipe and Fittings	1.6.1	G												
			Gas equipment connectors	1.5.2	G												
			Gas Piping System	1.5.2	G												
			Gas Piping System	2.2	G												
			Gas Piping System	3.3	G												
			Pipe Coating Materials	2.1	G												
			Transition fittings	2.2.8	G												
			Valves	2.3	G												
			Warning and identification tape	2.2.4	G												
			SD-06 Test Reports														
			Testing	3.16	G												
			Pressure Tests	3.16.1	G												
			Pressure Tests for Liquified	3.16.2	G												
			Petroleum Gas														
			Test With Gas	3.16.3	G												
			SD-07 Certificates														

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		23 11 25	Welders procedures and qualifications	1.5.1	G												
			assigned number, letter, or symbol	1.5.1	G												
			SD-08 Manufacturer's Instructions														
			pipe coating materials	2.1	G												
			SD-10 Operation and Maintenance Data														
			Gas facility system and equipment operation	1.3.1	G												
			Gas facility system maintenance	1.3.2	G												
			Gas facility equipment maintenance	1.3.3	G												
		23 31 13.00 40	SD-02 Shop Drawings														
			Record Drawings	1.3	G												
			SD-03 Product Data														
			Turning Vanes	2.3.4	G												
			Flexible Connectors	2.3.6	G												
			Flexible Duct Materials	2.3.9	G												
			Power Operated Dampers	2.3.12	G												
			Gravity Backdraft and Relief Dampers	2.3.11	G												
			Material, equipment, and fixture lists	Part 2													
			Galvanized Steel Ductwork Materials	2.2.1													

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		23 31 13.00 40	Brazing Materials	2.2.2													
			Mill-Rolled Reinforcing and Supporting Materials	2.2.3													
			Round Sheet Metal Duct Fittings	2.3.1													
			Manual Volume Dampers	2.3.10													
			Listing of product installations	3.2													
			SD-06 Test Reports														
			Ductwork Leakage Tests	3.4.2	G												
			Operational Tests	3.4.1													
			SD-07 Certificates														
			Turning Vanes	2.3.4	G												
			Dampers	2.3.5	G												
			Flexible Connectors	2.3.6	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.6	G												
			Power Operated Dampers	2.3.12	G												
		23 82 02.00 10	SD-02 Shop Drawings														
			Drawings	1.4													
			SD-03 Product Data														
			Materials and Equipment	2.1													
			Spare Parts	1.6													
			Posted Instructions	3.4													
			Verification of Dimensions	3.1													
			SD-07 Certificates														

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		23 82 02.00 10	Materials and Equipment	2.1													
			Service Organization	2.1.1													
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.4													
		23 82 23.00 40	SD-01 Preconstruction Submittals														
			Record of Existing Conditions														
			Listing of Product Installations	1.3													
			SD-02 Shop Drawings														
			Propeller Unit Heaters	2.2.1	G												
			SD-03 Product Data														
			Propeller Unit Heaters	2.2.1	G												
			Vibration Isolation	2.1	G												
			Material, equipment, and fixture list	2.2													
			Propellers	2.2.1.5													
			Horizontal Discharge Units	2.2.1.2													
			SD-05 Design Data														
			Connection Diagrams	2.1	G												
			Control Diagrams	2.1	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.3	G												
			Spare Parts	2.2													

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		23 82 23.00 40	Record Drawings	3.3													
		26 20 00	SD-03 Product Data														
			Circuit breakers		G A/E												
			Switches	2.6	G A/E												
			Motor controllers	2.8	G A/E												
			Combination motor controllers		G A/E												
			Manual motor starters	2.9	G A/E												
			SD-06 Test Reports														
			600-volt wiring test	3.5.2	G A/E												
			SD-10 Operation and Maintenance Data														
			Electrical Systems	1.5.1	G A/E												
		26 29 23	SD-02 Shop Drawings														
			Schematic diagrams	1.5.1	G A/E												
			Interconnecting diagrams	1.5.2	G A/E												
			Installation drawings	1.5.3	G A/E												
			SD-03 Product Data														
			Variable frequency drives	2.1	G A/E												
			SD-06 Test Reports														
			VFD Test	3.2.1													
			Performance Verification Tests	3.2.2													
			SD-08 Manufacturer's Instructions														
			Installation instructions	1.5.5													
			SD-09 Manufacturer's Field Reports														
			VFD Factory Test Plan	2.5.1	G A/E												

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		26 29 23	Factory test results	1.5.6													
			SD-10 Operation and Maintenance Data														
			Variable frequency drives	2.1													
		26 42 14.00 10	SD-02 Shop Drawings														
			Drawings	1.3.4	G AE												
			Contractor's Modifications	2.1.1	G AE												
			SD-03 Product Data														
			Equipment	2.1	G AE												
			Spare Parts	1.5													
			SD-06 Test Reports														
			Tests and Measurements	3.5	G AE												
			Contractor's Modifications	2.1.1	G AE												
			SD-07 Certificates														
			Cathodic Protection System	2.1													
			Services of 'Corrosion Expert'	1.3.1	G AE												
			SD-10 Operation and Maintenance Data														
			Cathodic Protection System	2.1													
			Training Course	3.6													
		26 51 00	SD-03 Product Data														
			LED lighting fixtures		G												
			Emergency lighting equipment		G												
			SD-06 Test Reports														
			Operating test	3.2													
		28 31 00.00 10	SD-02 Shop Drawings														

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		28 31 00.00 10	Detail Drawings	1.5.5	G												
			SD-03 Product Data														
			Storage Batteries	2.5													
			Low Battery Voltage														
			Spare Parts	1.4													
			Technical Data and Computer Software	1.6	G												
			Training	3.5													
			Testing	3.6													
			Smoke Detectors														
			Notification Appliances														
			Manual Stations														
			SD-05 Design Data														
			Battery Power		G												
			SD-06 Test Reports														
			Testing	3.6													
			SD-07 Certificates														
			Equipment	2.1													
			Qualifications	1.5.1													
			SD-10 Operation and Maintenance Data														
			Operating and Maintenance Instructions	1.3													
			Technical Data and Computer Software	1.6													
		31 23 00.00 20	SD-01 Preconstruction Submittals														

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		31 23 00.00 20	Dewatering work plan	1.7.1													
			SD-06 Test Reports														
			Borrow Site Testing	1.6	G												
			Fill and backfill	3.11.2.1													
			Select material	3.11.2.2													
			Density tests	3.11.2.4													
		32 01 19	SD-03 Product Data														
			Manufacturer's Recommendations	3.1.2.1	G AE												
			Equipment	3.1													
			SD-04 Samples														
			Materials	1.3.1	G AE												
			SD-06 Test Reports														
			Certified copies of the test reports	1.3.1	G												
		32 11 16.16	SD-03 Product Data														
			Materials	2.1	G AE												
			Geotextile		G AE												
			SD-05 Design Data														
			Gradation curve		G AE												
			SD-06 Test Reports														
			Bearing ratio		G AE												
			Liquid limit		G AE												
			Plasticity index		G AE												
			Dry weight		G AE												
			Percentage of wear		G AE												
			Gradation tests	3.4.2.1	G AE												

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		32 11 16.16	Density tests	3.4.2.3	G AE												
			SD-07 Certificates														
			Source	2.2	G AE												
		32 12 17.05	SD-05 Design Data														
			Job-Mix Formula	2.3	G AE												
			SD-06 Test Reports														
			Density Testing	3.5.1	G AE												
			SD-07 Certificates														
			Tack Coat Materials	2.5	G AE												
		32 16 13	SD-03 Product Data														
			Concrete	2.1	G AE												
			SD-06 Test Reports														
			Field Quality Control	3.7	G AE												
		32 92 19	SD-03 Product Data														
			Fertilizer	2.4													
			SD-07 Certificates														
			seed	2.1													
		33 11 23	SD-03 Product Data														
			Pressure regulator	3.1.3.1	G												
			Gas equipment connectors	2.5	G												
			Valves	2.4	G												
			Warning and identification tape	2.7	G												
			Risers	2.2.2	G												
			Transition fittings	2.2.3	G												
			Pneumatic emergency shutoff valves	2.14	G												

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																		(a)
		33 11 23	Liquid transfer pump	2.15	G													
			Vertical waterbath vaporizers	2.16	G													
			Propane sensors	2.17	G													
			Carbon Dioxide Cylinder	2.19														
			Manifolding System															
			SD-07 Certificates															
			Welder's qualifications	1.4.4	G													
			PE welder's qualifications	1.4.5	G													
			Welder's identification symbols	1.4.4	G													
			Documentation of training for all key personnel	1.4.1														
			SD-08 Manufacturer's Instructions															
			Pipe and fittings	2.2	G													
		33 51 15	SD-02 Shop Drawings															
			Pipe, Fittings, and Associated Materials	2.1														
			SD-03 Product Data															
			Materials and Equipment	2.1	G													
			Spare Parts	1.6	G													
			Pipe and Accessory Coatings	2.1	G													
			Plastic tubing for pneumatic system	2.6	G													
			Propane vapor meter	2.4.1	G													
			SD-05 Design Data															
			Connection and Abandonment Plan	1.4.2.2	G													

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		33 51 15	Jointing of Polyethylene Piping	1.4.1.2	G												
			SD-06 Test Reports														
			Piping System Pressure and Leakage Test Requirements	3.11.2	G												
			SD-07 Certificates														
			Welder's training, qualifications and procedures	1.4.1.1	G												
			SD-10 Operation and Maintenance Data														
			Gas distribution system and equipment operation	1.2.1	G												
			Gas distribution system maintenance	1.2.2	G												
			Gas distribution equipment maintenance	1.2.3	G												
		33 52 80	SD-03 Product Data														
			Field-Applied External Pipe Coating	3.2.1													
			SD-06 Test Reports														
			Qualification Testing	2.1.1													
			Qualification Testing	2.1.1													
			Acceptance Testing	2.1.1													
			Inspection Report Forms	2.1.2.2													
			Inspection Report Forms	3.4.2.2													
			Daily Inspection Reports	2.1.2.3													
			Daily Inspection Reports	3.4.2.3													

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		33 52 80	SD-07 Certificates														
			Contract Errors, Omissions, and Other Discrepancies	1.4.1													
			Corrective Action Procedures	1.4.2.1													
			Coating Work Plan	1.4.3													
			Qualifications of Certified Industrial Hygienist (CIH)	1.4.4.1													
			Qualifications of Pipe Coating Shop	1.4.4.8													
			Qualifications of Certified Protective Coatings Specialist (PCS)	1.4.4.2													
			Qualifications of Coating Inspection Company for Field Coating	1.4.4.3													
			Qualifications of Coating Inspector for Field Coating	1.4.4.4													
			Qualifications Of Individuals Performing Abrasive Blasting for Field Coating	1.4.4.5													
			Qualifications of Individuals Performing Coating Application for Field Coating	1.4.4.6													
			Qualifications of Individuals Performing Coating Application for Field Coating	1.4.4.6													

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Renovate SWOSU Fire Fighter Trainer (Building 510)

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT OR CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS	
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE			DATE OF ACTION
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 52 80	Qualifications of Individuals Operating Plural Component Equipment (Pump Tenders) for Field Coating	1.4.4.7													
			Qualifications of Coating Contractors	1.4.4.9													
			SD-11 Closeout Submittals Inspection Logbook	3.4.2.4													
		33 56 53	SD-02 Shop Drawings Installation	3.1	G												
			SD-07 Certificates Cleaning	2.5													
		33 59 00	SD-02 Shop Drawings Test Plan	3.1.1	G												
			SD-03 Product Data Tightness Tests	3.2.1													
			SD-04 Samples Fuel Supply	1.4.2													
			SD-06 Test Reports Tightness Tests	3.2.1	G												
			SD-07 Certificates Qualifications	1.3.1													
			API Inspection	1.3.3													
			Fuel Supply	1.4.2	G												
			Fuel Spills	1.4.3													
			Confirmed Leakage	3.2.1.3													

SECTION 01 33 29

SUSTAINABILITY REPORTING

02/15

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 189.1 (2011; Errata 1-2 2012; INT 1 2013; Errata 3-8 2013) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 008 (2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

U.S. DEPARTMENT OF ENERGY (DOE)

ISWG Guiding Principles (2008) High Performance and Sustainable Buildings Guidance

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

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUMMARY

This specification includes general requirements and procedures for this project to be constructed and documented per the federally mandated "Guiding Principles" (GP), Third Party Certification (TPC) requirements (if applicable), UFC 1-200-02, High Performance and Sustainable Building Requirements, and other requirements identified in this specification.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to this section. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Sustainability Notebook; G

Preliminary High Performance and Sustainable Building Checklist

SD-11 Closeout Submittals

Final Sustainability Notebook; G

Final High Performance and Sustainable Building Checklist; G

Amended Final Sustainability Notebook; G

1.4 GUIDING PRINCIPLES VALIDATION (GPV)

Provide construction related sustainability documentation to verify achievement of ISWG Guiding Principles Validation (GPV). Provide the following for GPV:

- a. Refer to HPSB Checklist (Paragraph 1.5.3.2).
- b. Obtain approval of any changes to the HPSB Checklist from the Contracting Officer at the Preconstruction Conference. Contracting Officer's approval establishes identified ISWG Guiding Principles Requirements as the project's sustainability goals.

No variations or substitutions to the HPSB Checklist are allowed without written consent from the Contracting Officer. Immediately bring to the attention of the Contracting Officer any changes that impact meeting the approved ISWG Guiding Principles Requirements for this project and demonstrate that change will not incur additional construction cost or increase the life cycle cost.

- c. Include all work required to incorporate the applicable ISWG Guiding Principles Requirements indicated on the HPSB Checklist and in this contract.
- d. Include construction related documentation to maintain an up-to-date Sustainability Notebook. Supplement construction related documentation containing the following components;
 - (1) HPSB Checklist
 - (2) Sustainability Action Plan

1.4.1 Sustainability Action Plan

Include the following information in the Sustainability Action Plan:

- a. Contractor's planned method to achieve each construction related GP requirement.

1.4.2 Costs

Contractor is responsible for all costs associated with constructing and demonstrating that project complies with approved ISWG Guiding Principles Requirements.

1.5 SUSTAINABILITY SUBMITTALS

Provide documentation in the Sustainability Notebook and the HPSB Checklist

to indicate compliance with the sustainability requirements of the project.

1.5.1 "S" Submittals for Sustainability Documentation

Submit the GPV sustainability documentation required in this specification as "S" submittals. Highlight GPV compliance data in "S" submittal.

1.5.2 SUSTAINABILITY NOTEBOOK

Provide and maintain a comprehensive Sustainability Notebook to document compliance with the sustainability requirements identified in the approved HPSB Checklist. Sustainability Notebook must contain all required data to support full compliance with the ISWG Guiding Principles Requirements. Sustainability Notebook is in the form of an Adobe PDF file; bookmarked at each ISWG Guiding Principles Requirement and sub-bookmarked at each document. Match format to ISWG Guiding Principles numbering system indicated herein. Maintain up to date information, spreadsheets, templates, and other required documentation with each current submittal.

Contracting Officer may deduct from the monthly progress payment accordingly if Sustainability Notebook information is not current, until information is updated and on track per project goals.

1.5.2.1 Sustainability Notebook Submittal Schedule

Provide Sustainability Notebook Submittals at the following milestones of the project:

a. Preliminary Sustainability Notebook

Submit preliminary Sustainability Notebook for approval at the Pre-construction conference. Include Preliminary High Performance and Sustainable Building Checklist.

b. Construction Progress Meetings. Update GP documentation in the Sustainability Notebook for each meeting.

c. Final Sustainability Notebook

Submit updated Sustainability Notebook within 60 days after the Beneficial Occupancy Date (BOD). Final progress payment retainage may be held by Contracting Officer until final sustainability documentation is complete. Include Final High Performance and Sustainable Building Checklist.

d. Amended Final Sustainability Notebook

Amend and resubmit the Final Sustainability Notebook to include commissioning, testing and balancing, and collection of performance requirements. Submit three (3) final electronic copies of the Amended Final Sustainability Notebook Submittal on DVDs to the Government no longer than 30 days after the GP and Cx designated data collection period.

1.5.3 HIGH PERFORMANCE SUSTAINABLE BUILDING (HPSB) CHECKLIST

Provide construction documentation that provides proof of and supports compliance with the completed HBSP Checklist.

1.5.3.1 HPSB Checklist Submittals

Submit an updated copy of the HPSB Checklist with each Sustainability Notebook submittal. Attach HPSB Checklist to DD1354 Real Property Record Submittal.

1.5.3.2 HPSB Checklist Public Access

Use the following as HPSB Checklist. Where Internet address appears on two lines, copy full address into Internet browser.

- a. Navy - NAVFAC Sustainability & Energy Data Record Card/High Performance and Sustainable Building Checklist
http://www.wbdg.org/pdfs/navfac_sustainable_energy_data_record_card.pdf

1.6 DOCUMENTATION REQUIREMENTS

Incorporate each of the following ISWG Guiding Principles Requirements into project construction; and provide documentation that proves compliance with each listed requirement. Items below are organized according to the ISWG Guiding Principles.

1.6.1 Commissioning

Work with the Commissioning Authority (CxA) to achieve requirements of the Commissioning plan and other contract document requirements at each stage of commissioning. Maintain up-to-date records of commissioning activities in the Sustainability Notebook, to include commissioning plan and summary commissioning report.

1.6.2 Energy Efficient Equipment

Provide only energy-using equipment that is Energy Star rated, or has the Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide equipment with efficiency in the top 25 percent for the type of equipment procured. Provide only energy using equipment that meets FEMP requirements for low standby power consumption. Energy efficient equipment can be found at: <http://www1.eere.energy.gov/femp/> and <http://www.energystar.gov/>. Provide the following documentation:

Proof that equipment is energy efficient and complies with the cited requirements.

1.6.3 Indoor Air Quality During Construction

Prior to construction, create indoor air quality plan. Implement IAQ plan during construction and flush building air before occupancy.

- a. Construction submittal documentation required:

- (1) For new construction and for renovation of unoccupied existing buildings, comply with ASHRAE 189.1 Section 10.3.1.4. (Indoor Air Quality (IAQ) Construction Management), with maximum outdoor air consistent with achieving relative humidity no greater than 60 percent. For renovation of occupied existing buildings, comply with ANSI/SMACNA 008 IAQ Guidelines for Occupied Buildings Under Construction.

- (2) Provide required documentation showing that after construction ends and prior to occupancy, new HVAC filters were installed, and building air was flushed out in accordance with UFC 1-200-02.

1.6.4 Recycled Content

Provide materials on this project with aggregated total recycled content greater than 10 percent. In addition, comply with 40 CFR 247. Refer to <http://www.epa.gov/cpg/products.htm> for assistance identifying products cited in 40 CFR 247. Provide the following documentation:

- a. Total amount of recycled content contained in building materials as a percentage of total cost of all building materials on the project (mechanical, electrical, and plumbing components, fire protection equipment and transportation are excluded).
- b. Substitutions: Contractor may submit for Government approval, proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions, submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.

1.6.5 Ozone Depleting Substances

Eliminate the use of ozone depleting substances during and after construction where alternative environmentally preferable products are available. Meet the requirements of ASHRAE 189.1 Section 9.3.3 Refrigerants for no CFC-based refrigerants in heating ventilation, air conditioning and refrigeration systems (except for fire suppression system requirements, covered elsewhere in this specification). Provide the following documentation:

- a. MSDS sheets for all refrigerants provided
- b. Products that meet the criteria of U.S. EPA Significant New Alternatives Policy, available at <http://www.epa.gov/ozone/snap/index.html>.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUSTAINABILITY COORDINATION

3.1.1 Coordinating Sustainability Documentation Progress

Provide sustainability focus and coordination at the following meetings to achieve sustainability goals. Contractor's designated sustainability professional responsible for GP documentation must participate in the following meetings to coordinate documentation completion.

- a. Pre-Construction Conference: Discuss the following: HPSB Checklist, Sustainability Action Plan, Construction submittal requirements and schedule, individuals responsible for achieving each Guiding Principle Requirement.

b. Construction Progress Meetings: Review GP sustainability requirements with project team including contractor and sub-contractor representatives. Demonstrate GP documentation is being collected and updated to the Sustainability Notebook.

(1) Facility Turnover Meetings: Review Sustainability Notebook for completeness and identify any outstanding issues relating to final documentation requirements.

(2) Final Sustainability Notebook Review

-- End of Section --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
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 SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2012) Fall Protection
ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2010) Articulating Boom Cranes
ASME B30.3	(2012) Tower Cranes
ASME B30.5	(2011) Mobile and Locomotive Cranes
ASME B30.8	(2010) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 241	(2013) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
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 2011) Safety and Health
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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 1910.146	Permit-required Confined Spaces
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes & Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.500	Fall Protection
29 CFR 1926.502	Fall Protection Systems Criteria and Practices
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC P-307	(2009; Change 1 Mar 2011; Change 2 Aug 2011) Management of Weight Handling Equipment
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1.2 DEFINITIONS

- a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.
- b. High Visibility Accident. Any mishap which may generate publicity or high visibility.
- c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.
- d. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).
- e. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

- (1) Death, regardless of the time between the injury and death, or the length of the illness;
 - (2) Days away from work (any time lost after day of injury/illness onset);
 - (3) Restricted work;
 - (4) Transfer to another job;
 - (5) Medical treatment beyond first aid;
 - (6) Loss of consciousness; or
 - (7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.
- f. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.
- g. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.) Any mishap meeting the criteria described above shall be documented in both the Contractor Significant Incident Report (CSIR) and using the NAVFAC prescribed Navy Crane Center (NCC) form submitted within five days both as provided by the Contracting Officer. Comply with additional requirements and procedures for accidents in accordance with NAVFAC P-307, Section 12.

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

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

Crane Critical Lift Plan; G

Proof of qualification for Crane Operators; G

SD-06 Test Reports

Notifications and Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph, "Notifications and Reports."

Accident Reports; G

Crane Reports

SD-07 Certificates

Hot work permit

License Certificates

Contractor Safety Self-Evaluation Checklist; G

Certificate of Compliance (Crane)

Submit one copy of each permit/certificate attached to each Daily Quality Control Report.

1.4 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Contracting Officer will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction conference. Complete the checklist monthly and submit with each request for payment voucher. An acceptable score of 90 or greater is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90 may result in retention of up to 10 percent of the voucher. Additionally, provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher. The Contracting Officer will submit a copy of the Contractor Safety Self-Evaluation and Monthly Exposure Report to the local safety and occupational health office.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and the federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

The SSHO must meet the requirements of EM 385-1-1 section 1 and ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each

project site to function as the Site Safety and Health Officer (SSHO). The SSHO shall be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO's training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17, entitled SITE SAFETY AND HEALTH OFFICER (SSHO), and all associated sub-paragraphs.

A Competent Person shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for acceptance in consultation with the Safety Office.

The SSHO shall have no other duties aside from enforcement of the safety requirements. Neither the QC Manager nor Superintendent shall perform duties of the SSHO even though both have safety inspection and compliance responsibilities.

1.6.1.2 Competent Person for Confined Space Entry

Provide a "Competent Person" to supervise the entry into each confined space. That individual must meet the requirements and definition of Competent Person as contained in EM 385-1-1.

1.6.1.3 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification. In addition, the Contractor shall comply with Contractor Operated Crane Requirements included in the latest revision of document NAVFAC P-307 Section 1.7.2 "Contractor Operated Cranes," and Appendix P, Figure P-1 and with 29 CFR 1926, Subpart CC.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

The SSHO shall:

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily quality control report.
- b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.
- c. Maintain applicable safety reference material on the job site.
- d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

- e. Implement and enforce accepted APPS and AHAs.
- f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.
- g. Ensure sub-contractor compliance with safety and health requirements.
- h. Maintain a list of hazardous chemicals on site and their material safety data sheets.
- i. Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

- a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).
- b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.6.3.2 Safety Meetings

Conduct and document meetings as required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily quality control report.

1.6.3.3 Periodic Inspections and AHAs

Periodic Inspections and AHAs shall be utilized while work is performed relative to the LP-Gas storage and piping system.

- 1. Periodic inspections will be performed according to the following schedule:
 - a. Daily and at the beginning of each shift worked.

- b. Daily Supervisor inspections
 - c. When new substances, processes, procedures or equipment, which present potential hazards, are introduced into our workplace.
 - d. When new previously unidentified hazards are recognized.
 - e. When occupational injuries and illnesses occur.
 - f. When we hire and/or reassign craft personnel or start a new task for which a hazard evaluation has not been previously conducted.
 - g. When workplace conditions warrant an inspection.
2. The AHA will be utilized to identify work place hazards. This is a check list that identifies safety hazard on projects. This is signed by employees during morning task/safety meeting.

1.6.3.4 Compliance Requirements

1. On-site management is responsible for ensuring that all safety and health policies and procedures are clearly communicated and understood by all employees. On-site managers/supervisors are expected to enforce the rules fairly and uniformly. All employees are responsible for using safe work practices, for following all directives, policies and procedures, and for assisting in maintaining a safe work environment.
2. Rules to maintain a safe work environment includes:
 - a. Informing workers of the provisions of the APP
 - b. Evaluating the safety performances of all workers
 - c. Recognizing employees who perform safe and healthful practices
 - d. Providing training to workers whose safety performance is deficient
 - e. Disciplining workers for failure to comply with safe and healthful practice

1.7 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. This project includes work on an existing propane system, which requires detailed planning in the APP. It is recommended that the APP incorporate a Site Specific Safety Plan for propane (SSSP). See attached document for reference. Incorporate elements of this document as appropriate to the site and to the intended execution plan. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety

and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality Control Manager, and any designated CSP or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site.

Continuously review and amend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.7.1 EM 385-1-1 Contents

In addition to the requirements outlined in Appendix A of USACE EM 385-1-1, the following is required:

- a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSSs, CHSTs. Specify the duties of each position.
- b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.
- c. Confined Space Entry Plan. Develop a confined and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA

standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

d. Crane Critical Lift Plan.

Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

- (1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400.
- (2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

e. Fall Protection and Prevention (FP&P) Program Documentation. The program documentation shall be site specific and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A qualified person for fall protection shall prepare and sign the program documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Revise the Fall Protection and Prevention Program documentation for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Program documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Program documentation in the Accident Prevention Plan (APP).

The FP&P Plan shall include a Rescue and Evacuation Plan in accordance with USACE EM 385-1-1, Section 21.M. The plan shall include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan in the Fall Protection and Prevention (FP&P) Plan, and as part of the Accident Prevention Plan (APP).

f. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

- g. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.9 DISPLAY OF SAFETY INFORMATION

Within one calendar day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

- a. Hot work permit.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.12 NOTIFICATIONS and REPORTS

1.12.1 Accident Notification

Notify the Contracting Officer as soon as practical, but no more than four hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.).

Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.12.2 Accident Reports

- a. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least \$20,000 in damages, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS). The Contracting Officer will provide copies of any required or special forms.
- b. Near Misses: Complete the applicable documentation in NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS).
- c. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form.

1.12.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.

1.12.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.13 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current

inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.14 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the Contracting Officer and Radiation Safety Office (RSO), and Contracting Oversight Technician (COT) for all specialized and licensed 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. Transportation of Regulated Amounts of Radioactive Material will comply with 49 CFR, Subchapter C, Hazardous Material Regulations. Local Fire authorities and the site Radiation Safety officer (RSO) shall be notified of any Radioactive Material use.

Transmitter Requirements: The base policy concerning the use of transmitters such as radios, cell phones, etc., must be adhered to by all contractor personnel. They must also obey Emissions control (EMCON) restrictions.

1.15 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.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

- a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

- 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.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with USACE EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be carried/available on each person.

Mandatory PPE includes:

- a. Hard Hat
- b. Appropriate Safety Shoes
- c. Reflective Vests

3.1.1 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Office or their designated representative prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e.

29 CFR Part 1910.1000). If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 15 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with ASSE/SAFE Z359.1.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment

during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

- (1) For work within 6 feet of an edge, on low-slope roofs, protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.
- (2) For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.4.4 Fall Protection for Working on Propane Storage Tanks

Implement fall protection control measures while performing any work on the tops of LP-Gas storage tanks in accordance with 29 CFR 1926.502.

3.4.5 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.6 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.7 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 SCAFFOLDING

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet maximum in height. The use of an adequate gate is required. Ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment

- a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
- b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions. Additionally, when material handling equipment is used as a crane it must meet NAVFAC P-307 requirements in Sections 1.7.2, "Contractor Operated Cranes," and 12, "Investigation and Reporting of Crane and Rigging Gear Accidents."
- c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.6.2 Weight Handling Equipment

- a. Equip cranes and derricks as specified in EM 385-1-1, section 16.
- b. Notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.
- c. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.
- d. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.
- e. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.
- f. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11, NAVFAC P-307 Figure 10-3 and ASME B30.5 or ASME B30.22 as applicable.
- g. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.
- h. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.
- i. All employees must keep clear of loads about to be lifted and of suspended loads.
- j. Use cribbing when performing lifts on outriggers.
- k. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
- l. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.
- m. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.
- n. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.
- o. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).
- p. Take steps to ensure that wind speed does not contribute to loss of

control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

3.6.3 Equipment and Mechanized Equipment

- a. Proof of qualifications for operator shall be kept on the project site for review.
- b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

3.6.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.7 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.7.1 Utility Locations

All underground utilities in the work area must be positively identified by a third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department.

3.7.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system.

3.7.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party,

independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.8 ELECTRICAL

3.8.1 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

3.9 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. Any potential for a hazard in the confined space requires a permit system to be used.

- 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 Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
- b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.
- c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

3.10 PROPANE

Comply with the requirements of:

1. Prior to undertaking any propane work, conduct a specific safety meeting with all safety, quality personnel; COTR/ROICC; and affected base personnel (including the Fire Marshall) to ensure all parties are aware of planned work and safety procedures. This meeting should be held at least twice: once before undertaking the removal of the interior propane piping, and again prior to the undertaking of any exterior work associated with the propane system.

-- End of Section --

GAS TRAINING & DEVELOPMENT LLC
Site Specific Safety Plan

RM 13-1593
Renovate SWOSU Firefighting Trainer
(Building 510)

Responsibility/Identification of Key Supervisor

On-Site Supervisor:

Day Shift Superintendent:

The above noted personnel have the authority for implementing the provisions of this program. All managers and supervisors are responsible for implementing and maintaining the SSSP Program in their work areas and for answering worker questions about the SSSP Program. A Copy of this SSSP Program is available from each manager and supervisor, as well as a hard copy situated in the safety box on-site.

Scope of Work – Propane System

1.0 Inspection of propane tanks

1.1 Visual inspection. Verify coating on tanks and piping is white in color and intact. Verify tanks are properly labeled. Specify purging of the tanks. Specify ultrasonic testing, leak survey and testing in the contract documents by a registered National Board of Boiler and Pressure Vessel Inspector.

2.0 Tank external/internal valves

2.1 Specify replacement in the contract documents.

3.0 Tank grounding

3.1 Visual inspection. Specify testing in the contract documents. Provide typical repair requirements.

4.0 Nitrogen tubing to the emergency shut-off valves

4.1 Visual inspection. Specify replacement in the contract documents.

5.0 Nitrogen supply

5.1 Visual inspection. Specify a pressure test and purge system. Specify replacement in the contract documents.

6.0 Electrical components at the propane tank farm and vaporizer area

6.1 Visual inspection. Specify testing in the contract documents. Provide typical repair requirements.

7.0 Propane Vaporizers

7.1 Specify purge and replacement in the contract documents.

8.0 Cathodic protection

8.1 Specify testing in the contract documents. Provide typical repair requirements.

9.0 Pipeline inspection

9.1 Specify inspection in accordance with API 570 the contract documents. Provide typical repair requirements.

10.0 Propane system

10.1 Specify appropriate testing in the contract documents. Provide typical repair requirements.

11.0 First and second stage regulator stations

11.1 Specify replacement in the contract documents.

12.0 Block and vent valves at trainer entrance

12.1 Specify replacement in the contract documents.

13.0 Propane detectors

13.1 Specify testing in the contract documents. Provide replacement requirements. Specify connection to the emergency response controls system.

14.0 Supply written plans, manuals and documents

For more detailed information about the job scope please contact the Site Gas Training & Development LLC project manager.

Hazard/Risk/Exposure Assessment

The major safety hazards/risks and exposures have been assessed as follows;

- Falling objects
- Working aloft
- Ladder/climbing
- Material handling
- Loud noises
- Stored Energy (LOCKOUT/TAGOUT)
- Slip and trips
- Confined Space (engulfment, hazardous atmosphere)

Control Measures

Gas Training & Development LLC, site staff will monitor the hazards/risks and exposures in accordance with this Safety Plan. The plan addresses the various hazards/risks and exposures, and the checklists and will bring any concerns or violations to the attention of the staff for correction. Unsafe or unhealthy work conditions; practices or procedures shall be corrected in a timely manner based on the severity of the hazard.

Minimum required protective equipment (PPE) will be:

- Eye protection
- Safety shoes
- Hearing protection
- Gloves (type required be task)
- Hard hat
- Fire extinguishers (as required)
- Fall protection (Safety harnesses are required when working on surfaces over six (4) feet high)*

Engineering Controls

- Ground Fault Circuit Interrupters (GFCI's) shall be used to protect all 120 VAC.
- Use bridges or trees for cords and hoses.
- Ensure housekeeping is kept up throughout the shift.
- *If a step ladder must be used when the worker's feet are on or above the fifth rung, the top of the ladder must be tied to a substantial anchor or a second worker must hold the ladder.
- Use safe work practices.

Administrative Controls

- Pre-Task safety meeting at the beginning of each.
- LOCK-OUT/TAG-OUT.
- Confined space program
- Site Specific Emergency Action Plan (EAP).

Periodic Inspections

Periodic inspections will be performed according to the following schedule:

- Daily and at the beginning of each shift worked.
- Daily Supervisor inspections
- When new substances, processes, procedures or equipment, which present potential hazards, are introduced into our workplace.
- When new previously unidentified hazards are recognized.
- When occupational injuries and illnesses occur.
- When we hire and/or reassign craft personnel or start a new task for which a hazard evaluation has not been previously conducted.
- When workplace conditions warrant an inspection.

Daily Safety Planner (Pre-Task)

The Pre-Task Planner will be utilized to identify work place hazards. This is a check list that identifies safety hazard on projects. This is signed by employees during morning task/safety meeting.

Compliance requirements

Management is responsible for ensuring that all safety and health policies and procedures are clearly communicated and understood by all employees. Managers and supervisors are expected to enforce the rules fairly and uniformly. All employees are responsible for using safe work practices, for following all directives, policies and procedures, and for assisting in maintaining a safe work environment.

Our system of ensuring that all workers comply with the rules and maintain a safe work environment includes:

- Informing workers of the provisions of our SSSP Program
- Evaluating the safety performances of all workers
- Recognizing employees who perform safe and healthful practices
- Providing training to workers whose safety performance is deficient
- Disciplining workers for failure to comply with safe and healthful practices

Written Progressive Disciplinary Program

Non-compliance with Site Specific Safety Plan will result in disciplinary action provided for in the Corporate Safety Program.

Hazardous Correction

Unsafe or unhealthy work conditions; practices or procedures shall be in a timely manner based on the severity of the hazards. Hazards shall be corrected according to the following procedures:

- When observed or discovered
- When an imminent hazard exists which cannot be immediately abated without endangering employee(s) and/or property, we will remove all exposed workers from the area, and notify customer of danger
- Workers necessary to correct hazards to be provided by others, as we are not a hazardous waste contractor or licensed to perform abatement.

Training and Instruction

All workers, including managers and supervisors, shall have training and instruction on general and job specific safety and health practices in accordance with 29 CFR 1910.110 and 29 CFR 1926. Training and instruction shall be provided as follow:

- When the SSSP Program is first established
- To all new employees
- To all workers given new job assignments for which training has not been previously provided
- Whenever new substances, processes, procedures or equipment are introduced to the work place and represent a new hazard
- Whenever the employer is made aware of a new or previously unrecognized hazard

- To supervisors to familiarize them with the safety and health hazards to which workers under their immediate direction and control maybe exposed
- To all workers with respect to hazard specific to each employee's job requirement

Workplace safety and health practices for all locations include, but are not limited to, the following:

- Explanation of the SSSP Program, Jacobs Safety Program, emergency action plan and fire prevention plan, and measures for reporting any unsafe conditions, work practices, injuries and when additional instruction is needed.
- Ensure proper use of appropriate clothing, including gloves, footwear, and personal protective equipment
- Daily Safety Planner System
- Required information about chemical hazards to which employees could be exposed and other hazard communication program information
- Availability of toilet, hand washing and drinking water facilities for impacted employees
- Provision for medical services and first aid including emergency procedures In addition, we provide specific instructions to all workers regarding hazardous unique to the job assignment, to the extent that such information was not already covered in other training.

Project Site Orientation

We orientate our workers about the following subjects;

- Good Housekeeping, fire prevention, safe practices for operating any construction equipment
- Safe access to all work areas
- Driver safety / Traffic safety
- Slips, trips, falls and back injuries
- Working aloft
- Ladder safety
- Ergonomic hazards, (lifting techniques, working on ladders, or stopped posture for prolonged periods)
- Personnel protective equipment
- Respiratory equipment
- Hazards communication
- Client requirements
- Job site physical hazards, such as heat stress, noise, and ionizing and non-ionizing radiation
- Personnel hygiene/blood borne pathogens and other biological hazards

Employee Communication System

We recognize that open, two-way communication between management and staff on health and safety issues is essential to an injury-free, productive workforce.

The following system of communication is designed to facilitate a continuous flow of safety and health information between management and staff in a form that is already understandable and consists of the following items:

- Site Specific Safety Plan (SSSP)
- Workplace safety and health training programs
- Regular required weekly safety meetings
- Effective communication of safety and health concerns between workers and supervisors
- Posted or distributed safety information
- New worker orientation, required for all new employees

Record Keeping

We have taken the following steps to implement and maintain the following records to document our SSSP Program:

- Records of hazard assessment inspections, including the person(s) or persons conducting the inspection, the unsafe conditions and work practices that have been identified and the action taken to correct the identified unsafe conditions and work practices, are recorded on a hazard assessment and correction form
- Documentation of safety and health training, and training providers are recorded in a worker training and instruction form.
- Monthly forward most recent copy of HSE statistics report to Jacobs for evaluation and reporting.

Inspection records and training documentation will be maintained according to the following checked schedule:

- For three years, except for training records of employees who have worked for less than one year which are provided to the worker upon termination of employment.
- Other records are required by contract specifications and or local regulations

Accident/Exposure Investigations

Procedures for investigating workplace accidents and hazardous substance exposure include:

- Responding to the accident scene as soon as possible.
- Reporting to Project Manager.
- Reporting immediately to the appropriate Client point of contact.
- Interviewing injured worker and witnesses.
- Examining the workers for factors associated with the accident exposure.
- Determining the cause of the accident/exposure.
- Taking corrective action to prevent the accident/exposure from reoccurring and recording the findings and corrective actions taken.
- *In the event of an incident/injury to a Contractor or Subcontractor employee, the Jacobs representative shall be notified ASAP, and a written report provided no later than 24 hours after the incident/injury.
 - *This notification shall include a detailed description of the accident or injury, including the names of those involved. Incident/Accident Investigation Report ([Attachment E](#)) and Witness Statement must be utilized to provide the required notification (plant report).
 - *OSHA Recordable injuries and minor injuries requiring first aid must be recorded.
- ***For any serious incident or injury:**
 - **First — Notify the Plant Shift Supervisor or designee immediately.** The Shift Supervisor will call 911 and implement appropriate Emergency Response procedures.
 - **Second — Provide First Aid for the injured** as required until Emergency Medical Technicians arrive.
 - **Third — secure the area** to ensure safety of other personnel.
 - **Fourth — Notify the Jacobs Rep** via phone or in person.

Emergency Action Plan

In the event an evacuation of the work site is necessary, it will be announced and all staff and visitors are to leave the area immediately and assemble at the pre-determined emergency meeting location. As indicated on the site specific EAP.

The supervisor shall contact the staff, any time an emergency action plan has been enacted. The on-site client representative will also be contacted immediately.

Site Specific Medical Emergency Plan

In the event serious injury or illness occurs to a Gas Training & Development LLC employee, he/she is to be taken immediately to the nearest Emergency Medical Center. For minor injuries such as simple cuts, sprains, etc. the employee will be taken to: nearest required medical treatment facility. If in doubt, assume the worst and transport the employee to the nearest Emergency Medical Center. The on-site Jacobs Representative

shall be notified as soon as possible. In case of serious injury or illness, the employee is to be sent immediately to the nearest hospital, by ambulance if necessary.

If the injury is the result of an accident on-site then an Accident Report Form - is to be filled out and submitted to the on-site Jacobs Representative.

Gas Training & Development LLC employees MUST report all injuries or illnesses, as soon as possible, to the site supervisor.

Hazard Communication Plan

In order to comply with OSHA 1910.1200, Hazard Communication Standard, the following written Hazard Communication Program has been established for Gas Training & Development LLC.

This written program is available at Gas Training & Development LLC headquarters in Aitkin, Minnesota for review by any interested employee. A list of all Chemicals that GTD LLC will bring on site has been given to the Site Safety Manager.

1. Container Labeling

A qualified employee shall verify that all in-coming containers received for use are clearly labeled to include:

- Content identification (The identity of the contents must match corresponding MSDS.)
- Appropriate hazard warnings, (including route of entry and target organs)

2. Material Safety Data Sheets (MSDS)

A qualified employee will be responsible for obtaining and maintaining material safety data sheets for the company.

It is Gas Training & Development LLC policy that when toxic or hazardous substances are received without a DMDS or the appropriate MSD is not on fill, that the chemical will not be accepted until such information is available.

A qualified employee will review incoming data sheets for new and significant health/safety information. They will see that any new information is passed on to the affected employees. If a MSDS is incomplete, the will request a new MSDS from the manufacture/supplier. MSDS sheets are available to each employee during his/her work shift. To obtain a copy of the MSDS call the main office at 218-927-4002.

3. Employees Training and Information

Gas Training & Development LLC management team is responsible for our employee-training program, and will ensure that all elements specified below are carried out.

Prior to starting work each new employee of Gas Training & Development LLC will attend a health and safety orientation and will receive information and training on the following:

- An overview of the requirements contained on OSHA Hazard Communication Standard
- 1910.1200
- Any operations in their work area where hazardous chemicals are present
- Location and availability of our written hazard program
- Physical and health hazard of the chemicals in their work area
- Methods and observation techniques used to determine the presence or release of toxic hazard substances in the work area
- Measures employees can take to protect themselves from hazards in their workplace
- Including specific procedures the employer has implemented to prevent exposure to hazardous chemicals such as appropriate work practices, emergency procedures and personal protective equipment
- Explanation of the labeling system and what the label information means
- Explanation of MSDS sheets and how employees can use this information to educate and protect themselves

Worker Training and Instruction Checklist

Supervisors and employees will be provided training that complies with the GTD LLC SSSP and the daily safety planer. This training will provide a general understanding our safety policies and how to fill out checklist to insure identification of safety hazards.

Substance Abuse Policy

Purpose:

Gas Training & Development LLC values its employees and recognizes their need for a safe and healthy work place. GTD LLC is committed to an alcohol and drug-free workplace to promote the safety and well-being of its Employees, customers, and the public affected by the conduct of Employees during the course and scope of their employment. The illegal use, manufacture, distribution, dispensation, possession and/or sale of drugs and the abuse of alcohol can have a negative impact on the ability of a person to perform specific functions, be productive, and maintain a safe working environment. The purpose of this policy is to initiate and maintain a program for achieving a drug and alcohol free work force in order to assure a safe and productive working environment to comply with the rules set forth by any Owner / Client / Government Agency as part of any contractual requirements.

Scope

Policy Applies to: All individuals to whom a conditional offer of employment has been made and current employees (including temporary employees).

Gas Training & Development LLC will not tolerate employees who report for duty while impaired by use of alcoholic beverages or drugs.

Employee Responsibilities

Employee responsibilities are as follows:

1. Report to work fit for duty.
2. Be in the appropriate mental and physical condition necessary to work in a safe and competent manner, free of the influence of drugs and alcohol.
3. Report to the employer any medications that may impair job performance or safety.
4. Consent to and participate in owner/employer required tests
5. Consent to the release of the drug test results to the employer, for specific purposes required by law.

All employees should report evidence of alcohol or drug abuse to a supervisor or a personnel representative immediately. In cases where the use of alcohol or drugs poses an imminent threat to the safety of persons or property, an employee must report the violation. Failure to do so could result in disciplinary action for the non-reporting employee.

Employees who violate the Substance Abuse Policy will be subject to disciplinary action, including termination.

Reasons for Testing

As a part of our policy to ensure a substance free workplace, Gas Training & Development LLC employees may be clinically tested for the presence of alcohol and/or drugs. Within the limits of federal and state laws, we reserve the right, at our discretion, to examine and test for drugs and alcohol. Some such situations may include, but not be limited, to the following:

1. Pre-employment Test

- All job applicants at this company will undergo screening for the presence of illegal drugs as a condition for employment.
- Any applicant with a positive test result will be denied employment at that time but may initiate another inquiry with the company after six months.

2. Post Accident Test

This test is required:

- When the employee is involved in any accident, incident, or event caused directly or indirectly by the employee.
- Results in treatment by a health care provider, or
- Results in damage to property.
- Including any serious near-miss incident
- The employee is to proceed directly for testing, or as soon as possible, and before the employee returns to the job site. It is the contractor/subcontractor's responsibility to see that testing is done within the time frame described above.
- The employee shall be tested for both drugs and alcohol.

3. Random Test

- GTD LLC employees may be required to immediate random drug and alcohol tests.
- Upon notification, the employee must report immediately to the testing facility.
- Notification of testing will be given to employees before the end of a shift to take the possibility of a 2 hour wait into consideration.

4. Probable Cause/Reasonable Suspicion Test

When there is Probable Cause/Reasonable Suspicion to believe that an employee is using or has used illegal drugs or is abusing or has abused alcohol;

Indicators of a substance-abuse problem and considered reasonably suspicious are as follows:

- **Information that an employee has caused, or contributed to, an accident while at work.** "Accident" includes injury to person(s) and/or damage to equipment or property.
- Observable phenomena while at work - such as direct observation of drug use or of the physical symptoms or manifestations of being under the influence of a drug.
 - Abnormal conduct or erratic behavior while at work or a significant deterioration in work performance.
 - A report of drug use provided by a reliable and credible source and independently corroborated.
 - Evidence that an individual has tampered with a drug test during his employment with the current employer.
 - Evidence that an employee has used, possessed, sold, solicited or transferred drugs while working or while on the employer's premises or while operating the employer's vehicle, machinery or equipment.

Whenever possible, the supervisor should have the employee observed by a second supervisor or manager before requiring testing. Employees who refuse substance testing under these circumstances will be terminated and forfeit workers' compensation medical and indemnity benefits.

Grounds for Termination or Discipline

1. *Illegal Drug Use*

The following are considered violations of the substance free workplace policy and are subject to discipline, including discharge or suspension from employment without pay and loss of Workers' Compensation benefits, even for the first offense:

- Refusing to take a company-required drug test
- Failing a company-required drug test (a *positive* test result)
- An employee bringing illegal drugs onto the company's premises or property (including company vehicles)
- Possession of illegal drugs or drug paraphernalia on the employee's person
- Using, consuming, transferring, selling or attempting to sell or transfer any form of illegal drug (as previously defined) while on company business or at any time during the hours between the beginning and ending of the employee's workday, whether on company property or not.

2. Alcohol Abuse

Alcohol testing is required for probable cause, post-accident/incident, and for immediate random testing situations.

The following are considered violations of the substance free workplace policy and are subject to discipline, including discharge or suspension from employment without pay and loss of Workers' Compensation benefits, even for the first offense:

- Refusing to take a company-required alcohol test
- Failing a company-required alcohol test
- An employee who is under the influence of alcoholic beverages at any time while on company business or at any time during the hours between the beginning and ending of the employee's workday, whether on company property or not (including company vehicles)
An employee shall be determined to be under the influence of alcohol if -
 - The employee's normal faculties are impaired due to consumption of alcohol
 - The employee has a blood-alcohol level of .04 or higher.
 - All alcohol test results with a confirmed BAC test level of .020 through .039 will require the employee to be removed from the owner's property for 24 hours or until the employee's next scheduled work time, whichever is longer.

GTD LLC may test for any or all of the following substances:

Drugs	Trade or Common Name
Alcohol	Liquor, Beer, Booze
Amphetamines	Biphphetamine, Desoxyn, Dexedrine
Cannabinoids	Marijuana, Pot, Grass
Cocaine	Coke, Flake, Snow, Crack
Phencyclidine HCl	PCP, Angel Dust
Methaqualone HCl	Quaalude
Opiates	Paregoric, Morphine, Tylenol with Codeine
Barbiturates	Phenobarbital, Amytal, Nembutal, Seconal
Benzodiazepines	Librium, Valium, Halcion, Restoril
Synthetic Narcotics	Methadone-Polophine, Methadose
Propoxyphene	Darvocet, Darvon-N, Dolene

Confidentiality

- All information, interviews, reports, statement memoranda, and drug-test results, written or otherwise, received by the employer through a drug-testing program are confidential communications and may not be used or received in evidence, obtained in discovery, or disclosed in any public or private proceedings, except in accordance with this section or in determining compensability
- This subsection (confidentiality) does not prohibit an employer, agent of an employer, or laboratory conducting a drug test from having access to employee drug-test information or using such information when consulting with legal counsel in connection with actions brought under or related to this section or when the information is relevant to its defense in a civil or administrative matter.

Specimen Collection

- Specimen collection will be conducted in accordance with 49 CFR Part 40 “Procedures for Transportation Workplace Drug and Alcohol Testing Programs”, and applicable state and federal law.
- Testing must be performed by a DHHS-approved laboratory.
- Ensure the security and integrity of the specimen according to accepted federal chain-of-custody guidelines.
- Make every reasonable effort to maintain the dignity of anyone submitting a specimen for this program.

If an employee is unable to provide a specimen at the time of testing, the employee could be required to wait up to two hours without leaving the test facility. Failure to remain and complete the test is the same as a refusal to test with the same sanctions as a positive test result.

Types of specimens:

- The employee will provide a urine specimen for the drug test.
- A photo ID must be presented at the time of collection to verify the employee’s identity.
- The employee will be asked to empty all pockets and display the contents to the collector.
- The employee will have up to two hours to provide a specimen. If the employee leaves before the two hours having not provided a specimen, this test will be processed the same as a refusal to test.
- The employee will be afforded privacy to provide the specimen unless
 - The collector observes evidence of an employee’s attempt to tamper with a specimen, or
 - The temperature range of the original specimen was out of normal range, or
 - It appears that the specimen was tampered with, or
 - The specimen was determined invalid by the laboratory
- Upon completion of testing the employee will be given a copy of the Custody and Control Form (CCF).

Medication Reporting Procedure

Employees or job applicants may confidentially report to the medical review officer (MRO) the use of prescription or nonprescription medications both before and after being tested. Additionally, employees and job applicants shall receive notice of the most common drugs or medications - by brand name or common name, as applicable, as well as by chemical name - which may alter or affect a drug test.

Reporting of Test Results

Employees or job applicants who receive a non-negative (positive) test result may contest or explain the result to the medical review officer within 5 working days after receiving written notification of the test result. If the employee's or job applicant's explanation or challenge is unsatisfactory to the medical review officer, the MRO shall report a positive test result.

All Substance abuse/Fit for Duty issues shall be reported directly to the Gas Training & Development LLC main office at: 218-927-4002

Return to Work

The employee must start a program of rehabilitation no less than 6 months prior to returning to a Gas Training & Development LLC job site, and must continue and complete the rehabilitation in order to be eligible to work on a GTD LLC job site. The rehabilitation must include the following steps:

1. The employee must arrange for an evaluation with a Substance Abuse Professional (SAP).
2. The SAP evaluation must specify that the employee:
 - Must attend education classes and/or treatment for at least 12 months.
 - Must perform the actions recommended by the SAP or assigned rehabilitation specialists.
 - Is subject to random follow-up testing not less than 3 times within the next 12 month from the employee's return to work test. In cases where the employee was unable to complete the follow-up test due to being laid off or out of town, etc., the length of time that was designated by the SAP to complete their follow-up test will be extended by the length of time the employee was not available for testing.
 - Will not be allowed to take another drug test for at least 14 days from the date of the first positive test.
3. The employee is required to submit a letter from the SAP to GTD LLC concerning their fitness for return to work including that the employee is eligible for a return to duty test.
4. The employee must take a return to duty test with negative results. These results must be submitted to Gas Training & Development LLC.
5. The employee must actively complete any ongoing rehabilitation and follow-up testing required by the SAP.
6. Arrangements for all costs are the responsibility of the employee.
7. If an employee tests positive within a 12 month period, the employee will not be eligible to retest for a period of one year and will not be permitted to work on GTD LLC job site during that period.

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

11/14

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 B564 Standard Specification for 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.

AACE INTERNATIONAL (AACE)
1265 Suncrest Towne Centre Drive
Morgantown, WV 26505-1876 USA
Ph: 304-296-8444
Fax: 304-291-5728
E-mail: info@aacei.org
Internet: <http://www.aacei.org>

ACOUSTICAL SOCIETY OF AMERICA (ASA)
1305 Walt Whitman Road, Suite 300
Melville, NY 11747-4300
Ph: 516-576-2360
Fax: 631-923-2875
E-mail: asa@aip.org
Internet: <http://asa.aip.org>

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC. (AIA/NAS)
1000 Wilson Blvd, Suite 1700
Arlington, VA 22209
Ph: 703-358-1052
Fax: 703-358-1052
E-mail: chris.carnahan@aia-aerospace.org
Internet: <http://www.aia-aerospace.org>

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
2800 Shirlington Road, Suite 300
Arlington, VA 22206
Ph: 703-575-4477
E-mail: info@acca.org

Internet: <http://www.acca.org>

AIR DIFFUSION COUNCIL (ADC)
1901 N. Roselle Road, suite 800
Schaumburg, IL 60195
Ph: 847-706-6750
Fax: 847-706-6751
E-mail: info@flexibleduct.org
Internet: <http://www.flexibleduct.org>

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: <http://www.amca.org>

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-524-8800
Fax: 703-562-1942
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: kconn@atis.org
Internet: <http://www.atis.org>

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
E-Mail: info@aluminum.org
Internet: <http://www.aluminum.org>

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square, Suite 550
Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
E-mail: customerservice@aamanet.org
Internet: <http://www.aamanet.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@ashto.org
Internet: <http://www.aashto.org>

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: <http://www.aatcc.org>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: <http://www.americanbearings.org>

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA/BOIL)
8221 Old Courthouse Road, Suite 202
Vienna, VA 22182
Ph: 703-356-7172
Internet: <http://www.abma.com>

AMERICAN BUREAU OF SHIPPING (ABS)
16855 Northchase Drive
Houston, TX 77060 USA
Ph: 281-877-5800
Fax: 281-877-5803
E-Mail: ABS-WorldHQ@eagle.org
Internet: <http://www.eagle.org>

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: <http://www.concrete.org>

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
8445 Freeport Parkway, Suite 350
Irving, TX 75063-2595
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: <http://www.concrete-pipe.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 FOREST AND PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Department
1111 Nineteenth Street NW, Suite 800
Washington, DC 20036
Ph: 800-890-7732 or 202-463-2766

Fax: 202-463-2791
E-mail: awcpubs@afandpa.org
Internet: <http://www.awc.org/>

AMERICAN GAS ASSOCIATION (AGA)
400 North Capitol Street N.W.
Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Internet: <http://www.aga.org>

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
1001 N. Fairfax Street, Suite 500
Alexandria, VA 22314-1587
Ph: 703-684-0211
Fax: 703-684-0242
E-mail: tech@agma.org
Internet: <http://www.agma.org>

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: <http://domensino.com/AHA/>

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)
3141 Fairview Park Dr, Suite 777
Falls Church, VA 22042
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
Bookstore: 800-644-2400
E-mail: aisc@ware-pak.com
Internet: <http://www.aisc.org>

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)
7012 South Revere Parkway, Suite 140
Centennial, CO 80112
Ph: 503-639-0651
Fax: 503-684-8928
E-mail: info@aitc-glulam.org
Internet: <http://www.aitc-glulam.org>

AMERICAN IRON AND STEEL INSTITUTE (AISI)
25 Massachusetts Avenue, NW Suite 800
Washington, DC 20001
Ph: 202-452-7100
Internet: <http://www.steel.org>

AMERICAN LADDER INSTITUTE (ALI)
2025 M St. NW
Washington, DC 20036
Ph: 202-367-1217
Fax: 202-973-8712
E-mail: info@americanladderinstitute.org
Internet: <http://www.americanladderinstitute.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)
1899 L Street, NW, 11th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: storemanager@ansi.org
Internet: <http://www.ansi.org/>

AMERICAN PETROLEUM INSTITUTE (API)
Internet: <http://www.api.org>

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION
(AREMA)
4501 Forbes Blvd., Suite 130
Lanham, MD 20706
Ph: 301-459-3200
Fax: 301-459-8077
E-mail: bcaruso@arema.org
Internet: <http://www.arema.org>

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
P.O. Box 28518
1711 Arlingate Lane
Columbus, OH 43228-0518
Ph: 800-222-2768; 614-274-6003
Fax: 614-274-6899
E-mail: tjones@asnt.org
Internet: <http://www.asnt.org>

AMERICAN SOCIETY FOR QUALITY (ASQ)
600 North Plankinton Avenue
Milwaukee, WI 53203
-or-
P.O. Box 3005
Milwaukee, WI 53201-3005
Ph: 800-248-1946; 414-272-8575
Fax: 414-272-1734
E-mail: help@asq.org
Internet: <http://www.asq.org>

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191

Ph: 703-295-6300; 800-548-2723
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
Ph: 847-699-2929
Internet: <http://www.asse.org>

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
18927 Hickory Creek Drive, Suite 220
Mokena, IL 60448
Ph: 708-995-3019
Fax: 708-479-6139
E-mail: staffengineer@asse-plumbing.org
Internet: <http://www.asse-plumbing.org>

AMERICAN WATER WORKS ASSOCIATION (AWWA)
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Internet: <http://aec.army.mil/>
Order from:
Defense Technical Information Center (DTIC)
Internet: <http://www.dtic.mil/dtic/>

U.S. CODE (USC)
Office of the Law Revision Counsel
Internet: <http://uscode.house.gov/>

U.S. DEFENSE INTELLIGENCE AGENCY (DIA)
Office of Corporate Communications
Joint Base Anacostia Bolling
Building 6000
Washington DC 20340-5100
PH: 202-231-5554
E-mail: dia-pao@dia.mil
Internet: <http://www.dia.mil>

U.S. DEFENSE LOGISTICS AGENCY (DLA)

Fort Belvoir, VA

Internet: <http://www.dla.mil>

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8871
Fax: 704-852-4189
E-mail: seed.ams@usda.gov
Internet: <http://www.ams.usda.gov/lsg/seed.htm>
Order Other Publications from:
U.S. Department of Agriculture, Rural Utilities Program
USDA Rural Development, Room 4051-S
Mail Stop 1510
1400 Independence Avenue SW
Washington, DC 20250-1510
Phone: (202) 720-9540
TTY: (800) 877-8339 (Federal Relay Service)
Fax: (202) 720-1725
Internet: http://www.rurdev.usda.gov/utilities_lp.html

U.S. DEPARTMENT OF COMMERCE (DOC)
1401 Constitution Avenue, NW
Washington, DC 20230
Ph: 202-482-2000
Internet: <http://www.commerce.gov/>
Order Publications From:
National Technical Information Service (NTIS)

Alexandria, VA 22312
Ph: 703-605-6050 or 800-533-6847
E-mail: customerservice@ntis.gov
Internet: <http://www.ntis.gov>

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
FAX: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: <http://www.ntis.gov>
Obtain Military Specifications, Standards and Related Publications
from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: <http://assist.daps.dla.mil/online/start/>; account
registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet: http://www.wbdg.org/references/docs_refs.php

U.S. DEPARTMENT OF ENERGY (DOE)
1000 Independence Avenue Southwest
Washington, D.C. 20585
Internet: www.eere.energy.gov

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)
HUD User
P.O. Box 23268
Washington, DC 20026-3268
Ph: 800-245-2691 or 202-708-3178
TDD: 800-927-7589
Fax: 202-708-9981
Internet: <http://www.huduser.org>

U.S. DEPARTMENT OF STATE (SD)
2201 C Street, NW
Washington, DC 20520
Internet: <http://www.state.gov>

U.S. DEPARTMENT OF TRANSPORTATION (DOT)
1200 New Jersey Ave. SE
Washington, DC 20590
Ph: 202-366-4000
Internet: <http://www.dot.gov>

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-272-0167
Internet: <http://www2.epa.gov/libraries>
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6050 or 1-688-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: <http://www.ntis.gov>

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
Order for sale documents from:
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Washington, DC 20401
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Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>
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Federal Aviation Administration
Department of Transportation
800 Independence Avenue, SW
Washington, DC 20591
Ph: 1-866-835-5322
Internet: <http://www.faa.gov>

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)
445 12th Street SW
Washington, DC 20554
Ph: 888-225-5322
TTY: 888-835-5322
Fax: 866-418-0232
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Fax: 866-418-0232
E-mail: gpoweb@gpo.gov
Internet: <http://www.gpoaccess.gov/>

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)
FHWA, Office of Safety
1200 New Jersey Ave., SE
Washington, DC 20590
Ph: 202-366-4000
Internet: <http://www.fhwa.dot.gov>
Order from:
Superintendent of Documents

U. S. Government Printing Office (GPO)
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Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1275 First St. NE
Washington, DC 20417
Ph: 202-501-1231
Internet: <http://www.gsaelibrary.gsa.gov/ElibMain/home.do>
Obtain documents from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Internet: <https://assist.dla.mil/online/start/>; account
registration required

U. S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, D.C. 20037
Ph: 800-795-1747
Internet: <http://www.usgbc.org>

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
Internet: <http://www.archives.gov>
Order documents from:
Superintendent of Documents
U.S. Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: <http://www.gpoaccess.gov>

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)
1322 Patterson Ave. SE, Suite 1000
Washington Navy Yard, DC 20374-5065
Ph: 202-685-9387
Internet: <http://www.navfac.navy.mil>

NAVAL FACILITIES ENGINEERING AND EXPEDITIONARY WARFARE CENTER
(NAVFAC EXWC)
1000 23rd Avenue
Port Hueneme, CA 93043-4301
Internet:
http://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc.html

U.S. NAVAL SEA SYSTEMS COMMAND (NAVSEA)
Commander Naval Sea Systems Command
1333 Isaac Hull Ave., SE
Washington Navy Yard, DC 20376-1080

Ph: 202-781-0000
E-mail: navsea_publicqueries@navy.mil
Internet: <http://www.navsea.navy.mil/PublicInquiries.aspx>

UL ENVIRONMENT (ULE)
2211 Newmarket Parkway, Suite 106
Marietta, GA 30067
Ph: 770-933-0638
Fax: 770-980-0072
E-mail: environment@ul.com
Intertet: <http://www.ul.com/environment>

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577
E-mail: CEC.us@us.ul.com
Internet: <http://www.ul.com/>
UL Directories available through IHS at <http://www.ihs.com>

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2711 LBJ Freeway, Suite 1000
Dallas, TX 75234
Ph: 972-243-3902
Fax: 972-243-3907
E-mail: info@uni-bell.org
Internet: <http://www.uni-bell.org>

WASHINGTON STATE ADMINISTRATIVE CODE (WAC)
Legislative Information Center
Gerry Sheehan, Coordinator
106 Legislative Building
Olympia, WA 98504-0600
Ph: 360-786-7573
Fax: 360-786-1529
E-mail: support@leg.wa.gov
Internet: <http://app.leg.wa.gov/wac/Default.aspx>

WASHINGTON STATE DEPARTMENT OF ECOLOGY (WSDE)
Washington State Department of Ecology
P.O. Box 447600
Olympia, WA 98504-7600
Ph: 360-407-7472
E-mail: ecypub@ecy.wa.gov
Internet:
<https://fortress.wa.gov/ecy/publications/UIPages/Home.aspx>

WATER ENVIRONMENT FEDERATION (WEF)
601 Wythe Street
Alexandria, VA 22314-1994
Ph: 800-666-0206
Fax: 703-684-2492
E-mail: inquiry@wef.org
Internet: <http://www.wef.org>

WATER QUALITY ASSOCIATION (WQA)
4151 Naperville Road
Lisle, IL 60532-3696
Ph: 630-505-0160

Fax: 630-505-9637
Internet: <http://www.wqa.org>

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
P.O. Box 23145
Portland, OR 97281
Ph: 503-639-0651
Fax: 503-684-8928
E-mail: info@wclib.org
Internet: <http://www.wclib.org>

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)
12503 SE Mill Plain Blvd, Ste 205
Vancouver, WA 98684
Ph: 360-693-9958
E-mail: info@wwpinstitute.org
Internet: <http://www.wwpinstitute.org>

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
1500 SW First Ave., Suite 870
Portland, OR 97201
Ph: 503-224-3930
Fax: 503-224-3934
E-mail: info@wwpa.org
Internet: <http://www.wwpa.org>

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
330 N Wabash Avenue, Suite 2000
Chicago, IL 60611
Ph: 312-321-6802
E-mail: wdma@wdma.com
Internet: <http://www.wdma.com>

WIRE ROPE TECHNICAL BOARD (WRTB)
7011A Manchester Blvd., #178
Alexandria, VA 22310-3203
Ph: 703-299-8550
Fax: 703-299-9253
E-mail: wrtb@usa.net
Internet: <http://www.wireropetechnicalboard.org>

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)
507 First Street
Woodland, CA 95695
Ph: 530-661-9591 or 800-550-7889
Fax: 530-661-9586
E-mail: info@wmmpa.com
Internet: <http://www.wmmpa.com>

WOOLMARK COMPANY (WBI)
Level 30, HSBC Centre
580 George St
Sydney NSW 2000
GPO Box 4177
Sydney, NSW, Australia 2001
Ph: 61 2 8295 3100
Fax: 61 2 8295 4100
E-mail: feedback@wool.com
internet: <http://www.woolmark.com>

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.00 20

QUALITY CONTROL

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 in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2 (2012; Errata 2013) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ASTM INTERNATIONAL (ASTM)

ASTM D6245 (2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation

ASTM D6345 (2010) Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 008 (2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 2011) Safety and Health Requirements Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED GBDC (2009) LEED Reference Guide for Green Building Design and Construction

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

Construction Quality Control (QC) Plan; G

Submit a Construction QC Plan prior to start of construction.

Indoor Air Quality (IAQ) Management Plan; G

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the Contracting Officer. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, (CQC) Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.

Deliver the following to the Contracting Officer during Construction:

- a. CQC Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.
- b. Contractor Production Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.
- c. Preparatory Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.
- d. Initial Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Initial Phase held.
- e. QC Specialist Reports: Submit the report electronically by 10:00 AM the next working day after each day that work is performed.
- f. Field Test Reports: Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.
- g. Monthly Summary Report of Tests: Submit the report as an electronic attachment to the CQC Report at the end of each month.
- h. Testing Plan and Log: Submit the report as an electronic attachment to the CQC Report, at the end of each month. A copy of the final Testing Plan and Log shall be provided to the OMSI preparer for inclusion into the OMSI documentation.
- i. Rework Items List: Submit lists containing new entries daily, in the same manner as the CQC Report.
- j. CQC Meeting Minutes: Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.
- k. 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. This QC program is a key element in meeting the objectives of NAVFAC Commissioning. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases

of control, submittal review and approval, testing, completion inspections, 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 must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.4.1 Commissioning

Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The Government has contracted a third-party Commissioning Authority (CxA) to lead this effort. The QC Program is a key to this process by coordinating, verifying and documenting measures to achieve the following objectives:

- a. Verify and document that the applicable equipment and systems are installed in accordance with the design intent as expressed through the Contract and according to the manufacturer's recommendations and industry accepted minimum standards.
- b. Verify and document that equipment and systems receive complete operational checkout by the installing contractors.
- c. Verify and document proper performance of equipment and systems.
- d. Verify that Operation and Maintenance (O&M) documentation is complete.
- e. Verify the Training Plan and training materials are accurate and provide correct instruction and documentation on the critical elements of the products, materials, and systems in the constructed facility. Verify that all identified Government operating personnel are trained.

The CxA will provide a project specific Commissioning Plan. Commissioning Plan will be made available to Contractor. Contractor shall cooperate with CxA during the commissioning process, and incorporate this into the QC plan.

1.4.2 Acceptance of the Construction Quality Control (QC) Plan

Acceptance of the QC Plan is required prior to the start of construction. The Contracting Officer 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 Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.4.3 Preliminary Construction Work Authorized Prior to Acceptance

The only construction 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.

1.4.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

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 only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control except for those phases of control designated to be performed by QC Specialists, 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 the QC Specialists, testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities.

1.5.1.2 Qualifications

An individual with a minimum of 10 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability.

A graduate of a four year accredited college or university program in one of the following disciplines: Engineering, Architecture, Construction Management, Engineering Technology, Building Construction, or Building Science, with a minimum of 10 years experience as a Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability.

1.5.2 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors." If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of

Engineers. Contact the Contracting Officer for information on the next scheduled class.

1.5.3 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site 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 must be the same as for the QC Manager.

1.5.4 QC Specialists Duties and Qualifications

Provide a separate QC Specialist at the work site for each of the areas of responsibilities, specified in Part 3, Execution, of the technical sections, who shall assist and report to the QC Manager and who will have no duties other than their assigned quality control duties. QC Specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings and be physically present at the construction site to perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility.

Qualification/Experience in Area of Responsibility	Area of Responsibility	Frequency
Propane Inspector	Repair, replacement, and installation of propane system 33 59 00, 33 51 15, and 33 11 23	Minimum three times a week during installation and full time during testing

1.5.5 Submittal Reviewers Duties and Qualifications

Provide Submittal Reviewers, other than the QC Manager or CA, qualified in the disciplines being reviewed, to review and certify that the submittals meet the requirements of this Contract prior to certification or approval by the QC Manager.

1.5.6 QC Administrative Assistant

Provide an Administrative Assistant at the work site until the work has been accepted. The primary duty is to assist the QC Manager in processing and maintaining files for submittals, preparing and publishing reports and meeting minutes. After primary duties are accomplished, other duties may be assigned provided the duties do not interfere with primary duties.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Construction Quality Control (QC) Plan

1.6.1.1 Requirements

Provide, for acceptance by the Contracting Officer, a Construction QC Plan submitted in a three-ring binder that includes a table of contents, with major sections identified with tabs, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing commissioning activities during the construction of the project:

- a. QC ORGANIZATION: A chart showing the QC organizational structure.
- b. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".
- c. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.
- d. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.
- e. 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 implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.
- f. 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. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.
- g. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs entitled "Accreditation Requirements", as applicable.
- h. 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. Use Government forms to log and track tests.
- i. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track, and complete rework items. Use Government forms to record and track rework items.
- j. DOCUMENTATION PROCEDURES: Use Government form.
- k. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the construction schedule. Include in the list of DFOWs, but not be limited to, all critical path activities on the NAS. Include all activities for which this specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network

Analysis Schedule for each design development stage and submittal package.

- l. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.
- m. PERSONNEL MATRIX: Not Applicable.
- n. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.
- o. TRAINING PROCEDURES AND TRAINING LOG: Procedures for coordinating and documenting the training of personnel required by the Contract.
- p. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications on subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.7 QC PLAN MEETINGS

Prior to submission of the QC Plan, the QC Manager will meet with the Contracting Officer to discuss the QC Plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC Plan requirements prior to plan development and submission and to agree on the Contractor's list of DFOWs.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to the start of construction, the QC Manager will meet with the Contracting Officer to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting shall be repeated.

1.8.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, Cx, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

- a. Waste Management Plan.
- b. IAQ Management Plan.
- c. Procedures for noise and acoustics management.

- d. Environmental Protection Plan.
- e. Environmental regulatory requirements.
- f. Cx Plan.

1.8.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as specified in the IAQ Management Plan. Coordinate prefunctional tests and startup testing with Cx.

1.8.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, QC Specialists, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Contracting Officer. Provide a copy of the signed minutes to all attendees and shall be included in the QC Plan.

1.9 QC MEETINGS

After the start of construction, conduct QC meetings once every two weeks by the QC Manager at the work site with the Project Superintendent, QC Specialists, the CA, and the foremen who are performing the work of the DFOs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the Contracting Officer within two working days after the meeting. The Contracting Officer may attend these meetings. As a minimum, accomplish the following 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 (RFI, etc.).
- f. Address items that may require revising the QC Plan.
- g. Review Accident Prevention Plan (APP).
- h. Review environmental requirements and procedures.
- i. Review Waste Management Plan.
- j. Review IAQ Management Plan.
- k. Review Environmental Management Plan.

- l. Review the status of training completion.
- m. Review Cx Plan and progress.

1.10 THREE PHASES OF CONTROL

Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFW.

1.10.1 Preparatory Phase

Notify the Contracting Officer at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the Project Superintendent, the CA, and the foreman responsible for the DFW. When the DFW will be accomplished by a subcontractor, that subcontractor's foreman shall attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFW:

- a. Review each paragraph of the applicable specification sections.
- b. Review the Contract drawings.
- c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- d. 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.
- e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.
- f. Examine the work area to ensure that the required preliminary work has been completed.
- g. Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- h. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.
- i. 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.
- j. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFW.
- k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

1. Review the Cx Plan and ensure all preliminary work items have been completed and documented.

1.10.2 Initial Phase

Notify the Contracting Officer at least two 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 QC Specialists, the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. 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.
- d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.
- e. Review the Cx Plan and ensure all preparatory work items have been completed and documented.

1.10.3 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:

- 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 rework items are being corrected.
- e. Assure manufacturers representatives have performed necessary inspections if required and perform safety inspections.
- f. Review the Cx Plan and ensure all work items, testing, and documentation has been completed.

1.10.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases 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.

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

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

1.11 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES.

1.12 TESTING

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

1.12.1 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 (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.

1.12.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology at <http://ts.nist.gov/ts/htdocs/210/214/214.htm>, the American Association of State Highway and Transportation Officials (AASHTO) program at <http://www.transportation.org/aashto/home.nsf/frontpage>, International Accreditation Services, Inc. (IAS) at <http://www.iasonline.org>, U. S. Army Corps of Engineers Materials Testing Center (MTC) at <http://www.wes.army.mil/SL/MTC/>, the American Association for Laboratory Accreditation (A2LA) program at <http://www.a2la.org/>, the Washington Association of Building Officials (WABO) at <http://www.wabo.org/> (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at <http://www.wacel.org/labaccred.html> (Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

1.12.3 Capability Check

The Contracting Officer 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.

1.12.4 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 Contracting Officer 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 must be signed by a testing laboratory representative authorized to sign certified test reports.

Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month, per the paragraph entitled "INFORMATION FOR THE CONTRACTING OFFICER".

1.12.5 Test Reports and Monthly Summary Report of Tests

Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month. Provide a copy of the signed test reports and certifications to the OMSI preparer for inclusion into the OMSI documentation.

1.13 QC CERTIFICATIONS

1.13.1 CQC Report Certification

Contain the following statement within the CQC Report: "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."

1.13.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

1.13.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the OMSI preparer for inclusion into the OMSI documentation.

1.14 COMPLETION INSPECTIONS

1.14.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager and the CA must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the Contracting Officer. The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government "Pre-Final Inspection".

1.14.2 Pre-Final Inspection

The Government and QCM will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the QCM as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work, or any particular increment thereof, if the project is divided into increments by separate completion dates.

1.14.3 Final Acceptance Inspection

Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, and others deemed necessary. Attendees for the Government will include the Contracting Officer, the CA, other FEAD/ROICC personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.15 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.15.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. 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" will be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter 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, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.15.2 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 must be

readily available to the Contracting Officer during all business hours.

- a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.
- b. All milestone inspections, arranged by Activity Number.
- c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.
- d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.
- e. An up-to-date copy of the Rework Items List.
- f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.
- g. Commissioning documentation including Cx checklists, schedules, tests, and reports.

1.15.3 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC Specialist reports shall include the same documentation requirements as the CQC Report for their area of responsibility. QC Specialist reports are to be prepared, signed and dated by the QC Specialists and shall be attached to the CQC Report prepared for the same day.

1.15.4 Testing Plan and Log

As tests are performed, the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the Contracting Officer. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE CONTRACTING OFFICER". Provide a copy of the final "Testing Plan and Log" to the OMSI preparer for inclusion into the OMSI documentation.

1.15.5 Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily CQC Report of each month. The Contractor is responsible for including those items identified by the Contracting Officer.

1.15.6 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by Section 01 78 00 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No.,

etc.). The QC Manager or QC Specialist assigned to an area of responsibility must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.16 NOTIFICATION ON NON-COMPLIANCE

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

1.17 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

Submit an IAQ Management Plan within 15 days after Contract award and not less than 10 days before the preconstruction meeting. Revise and resubmit Plan as required by the Contracting Officer. Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants.

1.17.1 Requirements During Construction

Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.

1.17.1.1 Control Measures

Meet or exceed the requirements of ANSI/SMACNA 008, Chapter 3, to help minimize contamination of the building from construction activities. The five requirements of this manual which must be adhered to are described below:

- a. HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.
- b. Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products shall have a low VOC content and be non-toxic to minimize building contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into building. Designate receiving/storage areas for incoming material that minimize IAQ impacts.
- c. Pathway interruption: When pollutants are generated use strategies such as 100 percent outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.
- d. Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep

work areas dry to discourage the growth of mold and bacteria. Take extra measures when hazardous materials are involved.

- e. Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other building materials.

1.17.1.2 Moisture Contamination

- a. Remove accumulated water and keep work dry.
- b. Use dehumidification to remove moist, humid air from a work area.
- c. Do not use combustion heaters or generators inside the building.
- d. Protect porous materials from exposure to moisture.
- e. Remove and replace items which remain damp for more than a few hours.

1.17.2 Requirements after Construction

After construction ends and prior to occupancy, conduct a building flush-out or test the indoor air contaminant levels. Flush-out must be a minimum two-weeks with MERV-13 filtration media as determined by ASHRAE 52.2 at 100 percent outside air, or in accordance with LEED GBDC. Air contamination testing must be consistent with EPA's current Compendium of Methods for the Determination of Air Pollutants in Indoor Air, and with the LEED GBDC. After building flush-out or testing and prior to occupancy, replace filtration media. Filtration media must have a MERV of 13 as determined by ASHRAE 52.2.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

-- End of Section --

SECTION 01 45 35

SPECIAL INSPECTIONS
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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2010) Specification for Structural Steel Buildings

1.2 SYSTEM DESCRIPTION

Perform Special Inspections as specified within construction documents and the 2012 International Building Code. Reference all specifications and drawings for additional information and requirements for Special Inspections & Testing. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in the specifications.

1.3 DEFINITIONS

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 indicated per this section and Chapter 17 of IBC 2012.

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 indicated per this section and Chapter 17 of IBC 2012.

Authority Having Jurisdiction, Building Official:

NAVFAC Midatlantic. The enforcement of the codes and standards as they pertain to facility projects can be delegated to the local components office's chief engineer's technical representative at the discretion of the components aforementioned office.

Special Inspector of Record (SIOR):

A licensed professional engineer, acceptable to the authority having jurisdiction, retained by the contractor as a third party quality assurance

agent in accordance with UFC 1-200-01. The SIOR shall submit qualifications acceptable to the authority having jurisdiction.

Duties of the Special Inspector of Record (SIOR): Duties of the SIOR shall include the following:

1. Supervise all special inspectors required by the contract Documents, UFC 3-301-01, and the IBC 2012.
2. Submit a letter to the authority having jurisdiction attesting to acceptance of the duties of SIOR. The letter shall bear the seal and signature of the SIOR.
3. Verify qualifications of all special inspectors.
4. Verify the qualifications of all fabricators.
5. Develop the special inspection project manual. The special Inspection Project Manual shall identify the specific special inspection requirements for the project as designated in the drawings, specifications (specifically, Part 3 of 01 45 35) and the 2012 International Building Code and include the applicable directives from the registered design professional and the authority having jurisdiction. The special Inspection Project Manual shall form the basis for the preconstruction meeting and shall become a part of the construction documents. At the Preconstruction Meeting, all information in the special Inspection Project Manual shall be reviewed to verify that all parties have a clear understanding of the special inspection provisions and the individual duties of each party.
6. Organize and preside over a special Inspection Meeting in which Representatives of the authority having jurisdiction, Contractor, and the registered design professional in responsible charge shall sign the log-in sheet documenting their presence at said meeting. A copy of the special Inspection Project Manual with the log-in sheet included shall be made available on the job site during Construction.
7. Attend preconstruction meetings.
8. Create and maintain an up-to-date file (3-ring binder) containing special Inspectors' Daily and Bi-Weekly Reports and the special Inspection Project Manual. This file shall be located in a conspicuous place in the project trailer/office to allow review by the building official and registered design professional in responsible charge.
9. Until all work requiring special inspection is complete, submit Bi-Weekly Reports to the authority having jurisdiction and the registered design professional in responsible charge. A report is required for each bi-weekly period and shall include, at minimum:
 - a. A brief summary of the work performed during the reporting time frame.
 - b. Changes and/or discrepancies with the mechanical or electrical component certification, drawings, and specifications that were observed during the reporting period.
 - c. Discrepancies which were resolved or corrected.

- d. A list of nonconforming items requiring resolution.
- e. All applicable test results.

When the work requiring special inspections is completed and all non-conforming items have been resolved to the satisfaction of the registered design professional in responsible charge, upon notification from the Contractor, the SIOR shall submit a final special inspection report to the authority having jurisdiction, the registered design professional in responsible charge, and the Contractor. The final special inspection report shall attest that special inspection has been performed on all work requiring special inspection and that all non-conforming work was resolved to the satisfaction of the design professional in responsible charge, the final special inspection report shall be signed, dated, and bear the professional seal of the SIOR.

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

SD-06 Test Reports
Special Inspection Reports

SD-07 Certificates

Special Inspector; G
Quality Control Plan; G
Contractor Statement of Responsibility
Testing Agency Qualifications

1.5 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.

1.6 SPECIAL INSPECTOR

Use Special Inspectors to perform Special Inspections required by this

section and the 2012 International Building Code. Submit certification including 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. 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.

1.7 CONTRACTOR STATEMENT OF RESPONSIBILITY

Contractor's statement of responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Concrete wall and chamfer cant repairs.
2. Wall heat shielding installation.

1.8 TESTING AGENCY QUALIFICATIONS

For testing agencies specified to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.9 SPECIAL INSPECTION REPORTS AND DOCUMENTS

Test and inspection reports: Prepare and submit certified written reports specified in other sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the work and test and inspection method.
7. Identification of product and specification section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected work complies with the contract document requirements. Discrepancies shall be brought to the immediate attention of the Contractor for correction. If

they are not corrected, the discrepancies shall be brought to the attention of the Contracting Officer and authorities having jurisdiction prior to the completion of that phase of the work.

12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.
14. Corrections of any discrepancies noted.

Manufacturer's field reports: Prepare written information documenting tests and inspections specified in other sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual specification sections.

Permits, licenses, and certificates: 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 standards and regulations bearing on performance of the work.

1.10 SPECIAL TESTS AND INSPECTIONS

Special tests and inspections: Engage a qualified testing agency and special inspector to conduct special tests and inspections required, as indicated in this section.

Special tests and inspections: Conducted by a qualified testing agency and special inspector as indicated in individual specification sections, as indicated in this section, and as follows:

1. Verify that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the work.
2. Notify contracting officer, construction manager, and contractor promptly of irregularities and deficiencies observed in the work during performance of its services.
3. Submit a certified written report of each test, inspection, and similar quality-control service to contracting officer, with copy to contractor and to authorities having jurisdiction.
4. Submit a final report of special tests and inspections at substantial completion, which includes a list of unresolved deficiencies to Contracting Officer, with copy to Contractor and to authorities having jurisdiction.
5. Interpret tests and inspections and state in each report whether tested

and inspected work complies with or deviates from the contract documents.

6. Retest and reinspect corrected work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

Perform Special Inspections where designated in the specifications, drawings, and the 2012 International Building Code:

3.1.1 Architectural, Mechanical, and Electrical Components

Refer to all the specifications.

3.2 CONCRETE CONSTRUCTION

1. Periodically inspect reinforcing steel and placement.
2. Periodically inspect anchors post-installed in hardened concrete members.
3. Periodically verify use of required design mix
4. At the time fresh concrete is sampled to fabricate specimens for strength test, continuously perform slump and air content tests, and determine the temperature of the concrete.
5. Continuously inspect concrete placement for proper application techniques.
6. Periodically inspect maintenance of specified curing temperature and techniques.
7. Periodically inspect formwork for shape, location and dimensions of the concrete members being formed.
8. Periodically inspect post installed anchor types, dimensions, hole dimensions, hole cleaning procedures, anchor spacing, edge distance, anchor embedment, and tightening/torque.

3.3 STEEL CONSTRUCTION

Welds (Tables N5.4-1 through N5.4-3, AISC 360-10)

- a. Continuously verify welding procedure specifications (WPSS) available.
- b. Continuously verify manufacturer certifications for welding consumables.
- c. Periodically perform material identification (type/grade)
- d. Periodically verify welder identification system.

- e. Periodically verify fit-up of groove welds (including joint geometry) for the following aspects: Joint preparation, dimensions (alignment, root opening, root face, bevel), cleanliness (condition of steel surfaces), tacking (tack weld quality and location, backing type and fit (if applicable)).
- f. Periodically verify fit-up of fillet welds for the following aspects: Dimensions (alignment, gaps at root), cleanliness (condition of steel surfaces), tacking (tack weld quality and location).
- g. Periodically verify use of qualified welders.
- h. Periodically inspect packaging and exposure control of welding Consumables.
- i. Periodically verify no welding is done over cracked tack welds.
- j. Periodically verify wind speed, precipitation, and temperature is within environmental condition limits.
- k. Periodically verify WPS are followed: Settings on welding equipment, travel speed, selected welding materials, shielding gas type/flow rate, preheat applied, interpass temperature maintained (Min./Max.), Proper position (f, v, h, oh).
- l. Periodically verify the following welding techniques: Interpass and final cleaning, each pass within profile limitations, each pass meets quality requirements.
- m. Periodically verify welds are cleaned.
- n. Continuously inspect size, length, and location of welds.
- o. Continuously verify welds meet the following acceptance criteria: Crack prohibition, weld/base-metal fusion, crater cross section, weld profiles, weld size, undercut, and porosity.
- p. Continuously inspect arc strikes.
- q. Continuously inspect K-Area.
- r. Continuously inspect repair activities.
- s. Continuously document acceptance or rejection of welded joint or member.

Bolts (Tables N5.6-1 through N5.6-3, AISC 360-10).

- a. Continuously verify manufacturer's certifications available for fastener materials.
- b. Periodically inspect fasteners marked in accordance with ASTM requirements.
- c. Periodically verify proper fasteners selected for the joint detail (Grade, type, bolt length if threads are to be excluded from shear plane).

- d. Periodically verify proper bolting procedure selected for joint detail.
- e. Periodically inspect pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used.
- f. Periodically inspect proper storage provided for bolts, nuts, washers and other fastener components.
- g. Periodically verify fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required.
- h. Periodically verify joint brought to the snug-tight condition prior to the pretensioning operation.
- i. Periodically verify fastener component not turned by the wrench prevented from rotating.
- j. Continuously verify and document acceptance or rejection of bolted connections.

3.4 FABRICATION

Periodically verify that the fabricator maintains detailed fabrication and quality control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards. Review the procedures for completeness and adequacy relative to the code requirements for the fabricator's scope of work.

Inspection of fabricators, in Note 1 above, shall not be required where the fabricator's work is done on the premises of a fabricator registered and approved to perform such work without special inspections. Approval shall be based upon review of the fabricators written procedural and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the Contracting Officer stating that the work was performed in accordance with the approved construction documents.

3.5 FIRE RESISTANCE MATERIALS AND COATINGS

Periodically inspect heat resistant sealant applied to concrete walls and chamfer cants in accordance with the building code and manufacturers specifications.

3.6 NONSTRUCTURAL RELATED ITEMS

For nonstructural related items that require special inspections see other discipline drawings and specifications.

3.7 TEST AND INSPECTION LOG

Test and inspection log: Prepare a record of tests and inspections. Include the following:

- 1. Date test or inspection was conducted.

2. Description of the work tested or inspected.
3. Date test or inspection results were transmitted to contracting officer.
4. Identification of testing agency or special inspector conducting test or inspection.

Maintain log at project site. Post changes and revisions as they occur. Provide access to test and inspection log for contracting officers's reference during normal working hours.

3.8 REPAIR AND PROTECTION

General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other specification sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the contract document requirements for cutting and patching.

Protect construction exposed by or for quality-control service activities.

Repair and protection are contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

3.9 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the specifications, drawings, and the 2012 International Building Code.

3.10 REPORTING AND COMPLIANCE PROCEDURES

- a. At end of each month, furnish to the Government electronic 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 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 241 (2013) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009) Manual on Uniform Traffic Control Devices

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

Construction site plan; G
Traffic control plan; G

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, 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.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00 PROJECT IDENTIFICATION. 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 Haul Roads

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

2.2.2 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.

2.2.3 Fencing

Contractor shall provide for barricading around all work areas to prevent public access.

2.2.3.1 Fencing

Fencing shall be provided along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against it.

Enclose the project work area and Contractor lay-down area with a 8 foot high chain link fence and gates with brown, UV light resistant, plastic fabric mesh netting (similar to tennis court or other screening). Remove

the fence upon completion and acceptance of the work. Intent is to block (screen) public view of the construction.

In addition, prior to the start of work, enclose those areas at the construction site which are not within the construction fence with a temporary safety fence, including gates and warning signs, to protect the public from construction activities. The safety fence shall match the base standard color (or bright orange where it protects excavated areas), shall be made of plastic from recovered materials containing 60-100 percent recovered content level plastic, a minimum of 42 inches high, supported and tightly secured to steel posts located on minimum 10 foot centers. Remove the fence from the work site upon completion of the contract.

2.2.3.2 Signs

Place warning signs at the construction area perimeter designating the presence of construction hazards requiring unauthorized persons to keep out. Signs must be placed on all sides of the project, with at least one sign every 300 feet. All points of entry shall have signs designating the construction site as a hard hat area.

2.2.4 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 TEMPORARY BULLETIN BOARD

Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

3.3 AVAILABILITY AND USE OF UTILITY SERVICES

3.3.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.3.2 Payment for Utility Services

- a. The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Carefully conserve any utilities furnished without charge.
- b. Reasonable amounts of the following utilities will be made available to the Contractor without charge.

Utility Services		
Electricity		
Potable Water		
Sanitary Sewer		

- c. The point at which the Government will deliver such utilities or services and the quantity available is as indicated. Pay all costs incurred in connecting, converting, and transferring the utilities to the work. Make connections, including providing transformers; and make disconnections. Under no circumstances will taps to base fire hydrants be allowed for obtaining domestic water.

3.3.3 Meters and Temporary Connections

At the Contractors expense and in a manner satisfactory to the Contracting Officer, provide and maintain necessary temporary connections, distribution lines, and meter bases (Government will provide meters) required to measure the amount of each utility. Notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will provide a meter and make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor will not make the final electrical connection.

3.4 TRAFFIC PROVISIONS

3.4.1 Maintenance of Traffic

- a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways 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.

3.4.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. 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, will be 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.

3.4.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations for Naval Station Great Lakes without notification to and approval by the Contracting Officer.

3.4.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.5 CONTRACTOR'S TEMPORARY FACILITIES

3.5.1 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.

3.5.2 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.

3.5.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. 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.

3.5.4 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another

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

3.5.5 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.

3.5.6 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. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

3.5.7 New Building

In the event a new building is constructed for the temporary project field office, it will be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. Equip the building with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. Provide a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building must be waterproof, supplied with a heater, have a minimum of two doors, electric lights, a telephone, a battery operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Approved sanitary facilities must be furnished. Screen the windows and doors and provide the doors with dead bolt type locking devices or a padlock and heavy duty hasp bolted to the door. Door hinge pins will be non-removable. Arrange the windows to open and to be securely fastened from the inside. Protect glass panels in windows by bars or heavy mesh screens to prevent easy access. In warm weather, furnish air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F. Any new building erected for a temporary field office must be maintained by the Contractor during the life of the contract and upon completion and acceptance of the work become the property of the Contractor and removed from the site.

3.5.8 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.

3.5.9 Storage Size and Location

The open site available for storage must be as indicated.

3.6 PLANT COMMUNICATION

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

3.7 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 any salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.8 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 areas used by the Contractor for the storage of equipment or material, or other use to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 19.00 20

TEMPORARY ENVIRONMENTAL CONTROLS

02/15

DISCLOSURE

This document is intended to summarize environmental requirements for contract work specific to Naval Station Great Lakes. Where differences with regulatory requirements or recognized advisory standards occur, the more stringent shall apply.

Naval Station Great Lakes (NSGL), including contractor project work site(s) are subject to Federal, State, and local regulatory inspection to verify compliance with environmental regulations. The Contractor shall cooperate fully with all regulatory representatives which may visit their job site and shall provide immediate notification to the Navy Contracting Officer. The contractor shall complete, maintain, and make available to the Navy Contracting Officer, NSGL designated representative or regulatory agency all documentation relating to environmental compliance as requested.

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. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004 (1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)

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

29 CFR 1910.120 Hazardous Waste Operations and Emergency Response

40 CFR 112 Oil Pollution Prevention

40 CFR 241 Guidelines for Disposal of Solid Waste

40 CFR 243 Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste

40 CFR 258 Subtitle D Landfill Requirements

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 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 355	Emergency Planning and Notification
40 CFR 372-SUBPART D	Specific Toxic Chemical Listings
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material, including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations.

Types of solid waste typically generated at construction sites may include:

- a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.
- b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.
- c. Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 60 mm (2.5 inch) particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may not be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.
- d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.
- e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.
- f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.
- g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company..
- h. Hazardous Waste: By definition, to be a hazardous waste a material must first meet the definition of a solid waste. Hazardous waste and

hazardous debris are special cases of solid waste. They have additional regulatory controls and must be handled separately. They are thus defined separately in this document.

Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas.

1.2.3 Hazardous Debris

As defined in Solid Waste paragraph, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.2.4 Chemical Wastes

This includes salts, acids, alkalizes, herbicides, pesticides, and organic chemicals.

1.2.5 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.6 Hazardous Waste

Any discarded material, liquid, solid, or gas, which meets the definition of hazardous material or is designated hazardous waste by the Environmental Protection Agency or State Hazardous Control Authority as defined in 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 271, 40 CFR 272, 40 CFR 273, 40 CFR 279, and 40 CFR 280.

1.2.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172.

Hazardous material is any material that:

- a. Is regulated as a hazardous material per 49 CFR 173, or
- b. Requires a Material Safety Data Sheet (MSDS) per 29 CFR 1910.120, or
- c. During end use, treatment, handling, packaging, storage, transpiration, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D.

Designation of a material by this definition, when separately regulated or controlled by other instructions or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this instruction for "control" purposes. Such material include ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated

biphenyls (PCBs). Nonetheless, the exposure may occur incident to manufacture, storage, use and demilitarization of these items.

1.2.8 Waste Hazardous Material (WHM)

Any waste material which because of its quantity, concentration, or physical, chemical, or infectious characteristics may pose a substantial hazard to human health or the environment and which has been so designated. Used oil not containing any hazardous waste, as defined above, falls under this definition.

1.2.9 Oily Waste

Those materials which are, or were, mixed with used oil and have become separated from that used oil. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residue or sludge, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, used oil and may be appropriately tested and discarded in a manner which is in compliance with other State and local requirements.

This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. These materials may be land filled provided that:

- a. It is not prohibited in other State regulations or local ordinances
- b. The amount generated is "de minimus"
- c. It is the result of minor leaks or spills resulting from normal process operations
- d. All free-flowing oil has been removed to the practical extent possible

Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, a hazardous waste determination must be performed prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.2.10 Regulated Waste

Those solid wastes that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.2.11 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)

chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212) methyl bromide
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-500 (CFC-500)
chlorofluorocarbon-502 (CFC-502)
chlorofluorocarbon-503 (CFC-503)
halon-1211
halon-1301
halon-2402
carbon tetrachloride
methyl bromide
methyl chloroform

Class II ODS is defined in Section 602(s) of The Clean Air Act and includes the following chemicals:

hydrochlorofluorocarbon-21 (HCFC-21)
hydrochlorofluorocarbon-22 (HCFC-22)
hydrochlorofluorocarbon-31 (HCFC-31)
hydrochlorofluorocarbon-121 (HCFC-121)
hydrochlorofluorocarbon-122 (HCFC-122)
hydrochlorofluorocarbon-123 (HCFC-123)

hydrochlorofluorocarbon-124 (HCFC-124)
hydrochlorofluorocarbon-131 (HCFC-131)
hydrochlorofluorocarbon-132 (HCFC-132)
hydrochlorofluorocarbon-133 (HCFC-133)
hydrochlorofluorocarbon-141 (HCFC-141)
hydrochlorofluorocarbon-142 (HCFC-142)
hydrochlorofluorocarbon-221 (HCFC-221)
hydrochlorofluorocarbon-222 (HCFC-222)
hydrochlorofluorocarbon-223 (HCFC-223)
hydrochlorofluorocarbon-224 (HCFC-224)
hydrochlorofluorocarbon-225 (HCFC-225)
hydrochlorofluorocarbon-226 (HCFC-226)
hydrochlorofluorocarbon-231 (HCFC-231)
hydrochlorofluorocarbon-232 (HCFC-232)
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hydrochlorofluorocarbon-242 (HCFC-242)
hydrochlorofluorocarbon-243 (HCFC-243)
hydrochlorofluorocarbon-244 (HCFC-244)
hydrochlorofluorocarbon-251 (HCFC-251)
hydrochlorofluorocarbon-252 (HCFC-252)
hydrochlorofluorocarbon-253 (HCFC-253)
hydrochlorofluorocarbon-261 (HCFC-261)
hydrochlorofluorocarbon-262 (HCFC-262)

hydrochlorofluorocarbon-271 (HCFC-271)

1.2.12 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (e.g., thermostats) and lamps (e.g., fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

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

SD-01 Preconstruction Submittals

Solid Waste Management Permit; G

Dirt and Dust Control Plan; G

Preconstruction Survey; G

Environmental Management Plan; G

Solid Waste Management Plan and Permit; G

Regulatory Notifications; G

Storm Water Pollution Prevention Plan; G

Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities); G

Contractor Hazardous Material Inventory Log; G

ECATTS certificate of completion; G

SD-06 Test Reports

Laboratory Analysis

Disposal Requirements

Storm Water Inspection Reports for General Permit

Contractor 40 CFR employee training records

Solid Waste Management Report; G

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Storm Water Pollution Prevention Plan compliance notebook; G

Waste Determination Documentation

Disposal Documentation for Hazardous and Regulated Waste

Contractor 40 CFR Employee Training Records

Solid Waste Management Report

Contractor Hazardous Material Inventory Log; G

Hazardous Waste/Debris Management

Regulatory Notifications

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

The Contractor may be required to promptly conduct tests and procedures for the purpose of assessing whether construction operations are in compliance with Applicable Environmental Laws. Analytical work shall be done by qualified laboratories; and where required by law, the laboratories shall be certified.

1.4.1 Environmental Compliance Assessment Training and Tracking System

The QC Manager is responsible for environmental compliance on projects unless an Environmental Manager is named. The QC Manager (and Alternate QC Manager) or Environmental Manager shall complete ECATTS Training prior to starting respective portions of on-site work under this contract. If personnel changes occur for any of these positions after starting work, replacement personnel shall complete ECATTS training within 14 days of assignment to the project.

Submit an ECATTS certificate of completion for personnel who have completed the required "Environmental Compliance Assessment Training and Tracking System (ECATTS)" training. This training is web-based and can be accessed from any computer with Internet access using the following instructions.

Register for NAVFAC Environmental Compliance Assessment Training and Tracking System, by logging on to <http://navfac.ecatts.com/>. Obtain the password for registration from the Contracting Officer.

This training has been structured to allow contractor personnel to receive credit under this contract and also to carry forward credit to future contracts. Contractors shall ensure that the QC Manager (and Alternate QC Manager) or Environmental Manager review their training plans for new modules or updated training requirements prior to beginning work. Some training modules are tailored for specific State regulatory requirements; therefore, Contractors working in multiple states will be required to re-take modules tailored to the state where the contract work is being performed.

ECATTS is available for use by all contractor and subcontractor personnel associated with this project. These other personnel are encouraged (but not required) to take the training and may do so at their discretion.

1.4.2 Conformance with the Environmental Management System

The Contractor shall perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). The Contractor shall perform work in a manner that conforms to objectives and targets, environmental programs and operational controls identified by the EMS. The Contractor will provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, the Contractor shall take corrective and/or preventative actions. In addition, the Contractor shall ensure that its employees are aware of their roles and responsibilities under the EMS and how these EMS roles and responsibilities affect work performed under the contract.

The Contractor is responsible for ensuring that their employees receive applicable environmental and occupational health and safety training, and keep up to date on regulatory required specific training for the type of work to be conducted onsite. All on-site Contractor personnel, and their subcontractor personnel, performing tasks that have the potential to cause a significant environmental impact shall be competent on the basis of appropriate education, training or experience. Upon contract award, the Contracting Officer's Representative will notify the installation's EMS coordinator to arrange EMS training. The installation's EMS coordinator shall identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. The Contractor shall provide training documentation to the Contracting Officer. The installation's EMS coordinator shall retain associated records.

1.5 QUALITY ASSURANCE

1.5.1 Preconstruction Survey

Perform a Preconstruction Survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.5.2 Regulatory Notifications

The Contractor is responsible for all regulatory notification requirements

in accordance with Federal, State and local regulations. In cases where the Navy must also provide public notification (such as storm water permitting), the Contractor must coordinate with the Contracting Officer. The Contractor shall submit copies of all regulatory notifications to the Contracting Officer prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.5.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the Contracting Officer and Naval Station Public Works Department Environmental Division Director (PWD-EV) to discuss the proposed Environmental Management Plan. Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, required permits, permit requirements, and other measures to be taken.

1.5.4 Environmental Manager

Appoint in writing an Environmental Manager for the project site. The Environmental Manager will be directly responsible for coordinating contractor compliance with Federal, State, local, and station requirements.

The Environmental Manager will ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the Environmental Management Plan; ensure that all environmental permits are obtained, maintained, and closed out; ensure compliance with Storm Water Program Management requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers).

This can be a collateral position; however, the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out.

1.5.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. The Contractor will ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with Federal, State and local regulatory requirements for RCRA Large Quantity Generator. The Contractor will provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon

Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements as defined in 40 CFR 265 for a Large Quantity Generator facility. Submit these training records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 ENVIRONMENTAL MANAGEMENT PLAN

Prior to initiating any work on site, the Contractor will meet with the Contracting Officer to discuss the proposed Environmental Management Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Contractor's Environmental Management Plan shall incorporate construction related objectives and targets from the installation's Environmental Management System. The Environmental Management Plan will be submitted in the following format and shall include the elements specified below.

a. Description of the Environmental Management Plan

(1) General overview and purpose

(a) A brief description of each specific plan required by environmental permit or elsewhere in this contract. The Permit Record of decision (PROD) form found in UFC 3-200-10N may be used to help accomplish this task.

(b) The duties and level of authority assigned to the person(s) on the job site that oversee environmental compliance.

(c) A copy of any standard or project specific operating procedures that will be used to effectively manage and protect the environment on the project site.

(d) Communication and training procedures that will be used to convey environmental management requirements to contractor employees and subcontractors.

(e) Emergency contact information (office phone number, cell phone number, and e-mail address).

(2) General site information

(3) A letter signed by an officer of the firm appointing the Environmental Manager and stating that he/she is responsible for managing and implementing the Environmental Program as described in this contract. Include in this letter the Environmental Manager's authority to direct the removal and replacement of non-conforming work.

b. Management of Natural Resources

- (1) Land resources
 - (2) Tree protection
 - (3) Replacement of damaged landscape features
 - (4) Temporary construction
 - (5) Stream crossings
 - (6) Fish and wildlife resources
 - (7) Wetland areas
- c. Protection of Historical and Archaeological Resources
- (1) Objectives
 - (2) Methods
- d. Storm Water Management and Control
- (1) Ground cover
 - (2) Erodible soils
 - (3) Temporary measures
 - (a) Mechanical retardation and control of runoff
 - (b) Vegetation and mulch
 - (4) Effective selection, implementation and maintenance of Best Management Practices (BMPs).
- e. Protection of the Environment from Waste Derived from Contractor Operations
- (1) Control and disposal of solid and sanitary waste.
 - (2) Control and disposal of hazardous waste (Hazardous Waste Management Section)

Contractor is required to use hazardous waste disposal facilities pre-approved by NSGL PWD-EV Division. A list of approved disposal facilities is available from the Contracting Officer upon request.

This item will consist of the management procedures for all hazardous waste to be generated. The elements of those procedures will coincide with the Activity Hazardous Waste Management Plan. A copy of the Activity Hazardous Waste Management Plan will be provided by the Contracting Officer. As a minimum, include the following:

- (a) Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;
- (b) Sampling/analysis plan;

- (c) Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);
- (d) Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);
- (e) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268);
- (f) Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;
- (g) Used oil management procedures in accordance with 40 CFR 279;
- (h) Pollution prevention\hazardous waste minimization procedures;
- (i) Plans for the disposal of hazardous waste by permitted facilities;
- (j) Procedures to be employed to ensure all required employee training records are maintained.

f. Prevention of Releases to the Environment

- (1) Procedures to prevent releases to the environment
- (2) Notifications in the event of a release to the environment

g. Regulatory Notification and Permits

- (1) List what notifications and permit applications must be made. Demonstrate that those permits have been obtained by including copies of all applicable, environmental permits. Be aware that some permits required under the Environmental Management Plan require up to 30 days advance regulator notice before site work may begin.

3.1.1 Environmental Management Plan Review

Within thirty days after the Contract award date, submit the proposed Environmental Management Plan for further discussion, review, and approval. Commencement of work will not begin until the environmental management plan has been approved.

3.1.2 Licenses and Permits

The Contactor including their representative(s) are prohibited from initiating contact with local, State, or federal agencies on behalf of Naval Station Great Lakes (NSGL) without prior written consent of the Navy Contracting Officer. This requirement shall apply to all correspondence, permits, spills, or environmental emergency incidents occurring on NSGL.

Permits. Draft copy of all permits or other authorizations shall be submitted to the NSGL Public Works Department Environmental Division (PWD-EV) for approval **prior to submission** to the pertinent regulatory agency. Permits or other regulatory authorizations shall be received by

the Contractor with copy provided to the Navy Contracting Officer prior to start of field work. Permits or regulatory authorizations include but not limited to - Storm Water Permits, and NSGL Temporary Tank Authorization.

Obtain licenses and permits pursuant to the "Permits and Responsibilities" FAR Clause 52.236-7.

The following permits will be obtained by the Contracting Officer:

- a. _____
- b. _____
- c. _____

The Contractor is responsible for conforming to all permit requirements and performing all quality control inspections of the work in progress, and to submit notifications and certifications to the applicable regulatory agency via the Contracting Officer.

No permits will be obtained by the Contracting Officer.

Where required by the State regulatory authority, the inspections and certifications will be provided through the services of a Professional Engineer (PE), registered in the State where the work is being performed. Where a PE is not required, the individual must be otherwise qualified by other current State licensure, specific training and prior experience (minimum 5 years). As a part of the quality control plan, which is required to be submitted for approval by the quality control section, provide a sub item containing the name, appropriate professional registration or license number, address, and telephone number of the professionals or other qualified persons who will be performing the inspections and certifications for each permit.

3.2 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. If the work is near streams, lakes, or other waterways, conform to the national permitting requirements of the Clean Water Act.

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

Protect existing trees and vegetation which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from un-cleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed. Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and

landscape features. Obtain Contracting Officer's approval before replacement.

The Contracting Officer's approval is required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain Contracting Officer's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the Contracting Officer.

3.2.1 Storm Water Pollution Prevention

3.2.1.1 Construction Storm Water Management - Contractor Guidance Manual

Naval Station Great Lakes (NSGL) has developed a guidance manual to provide contractors working at NSGL with expectations and procedures regarding management of construction storm water discharges from NPDES (National Pollution Discharge Elimination System) permitted projects. The manual is provided by the Contracting Officer and becomes part of the contract documents.

3.2.1.2 Storm Water Pollution Prevention Plan Compliance Notebook

The contractor shall create and maintain a three binder of documents that demonstrate compliance with the Storm Water Construction Activity permit. The binder shall include a copy of the permit Registration Statement, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports, copies of correspondence with the Illinois EPA and a copy of the permit Notice of Termination. At the completion of the project the folder shall become the property of the Government. The compliance notebook shall be provided to Contracting Officer. An advance copy of the Registration Statement shall be provided to the Contracting Officer immediately after the form is presented to the permitting agency.

3.2.1.3 Storm Water Drainage and Construction Dewatering

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or into Skokie Creek or the water of Lake Michigan including Pettibone Creek and its tributaries without prior written specific authorization of the Environmental Division. Contractor shall submit specific details of procedures that will be applied if project will impact water of Lake Michigan including Pettibone Creek and its tributaries or environmentally sensitive areas. Discharge of hazardous substances will not be permitted under any circumstances.

Construction site runoff will be prevented from entering any storm drain or into Skokie Creek or the Lake Michigan including Pettibone Creek and its tributaries directly by the use of straw bales or other method suitable to the PWD Environmental Division. Contractor will provide erosion protection of the surrounding soils.

Construction Dewatering shall not be discharged to the sanitary sewer. If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Authorization for any contaminated groundwater release shall be obtained in advance from the base Public Works Department Environmental Division Director. Discharge of hazardous substances will not be permitted under any circumstances.

3.2.2 Landscaping

- a. Replacement vegetation includes trees, bushes/shrubs, flowers/plants and grass/lawn seed. Contractor is required to submit a proposed landscape plan for approval which identifies replacement vegetation with- common name, scientific nomenclature, quality of each and proposed planting sites.
- b. For lawn and grass seeding, permanent seed mix shall be used unless otherwise directed. Seed shall be applied at a time best suited for germination of the selected species. Seeded areas shall achieve 95-percent coverage of the selected species and be weed free at the end of the establishment period. Sodded areas shall achieve 100 percent coverage and be weed free.
- c. Replacement vegetation shall be native species appropriate for the locality obtained from nursery stock within 35-ground mile distance from NSGL. They shall be guaranteed by the Contractor against loss, disease or otherwise degradation for minimum of two-years from date of acceptance by the Navy.
- d. Contractor is responsible for all maintenance of replacement to include, but not limited to watering, weeding, trimming/ cutting, and necessary maintenance care.
- e. Vegetation failing to flourish or otherwise survive shall be replaced in kind at Contractor expense.

3.2.3 Pest Control

- a. Pesticides shall be currently EPA registered and approved in advance by the PWD Environmental Division Pest Program Manager.
- b. Pesticides include herbicides, weed killers, weed-feed mixes, pesticides, rodenticides, fungicides etc.
- c. Applicators must be currently licensed/certified by the State of Illinois for the applicable pesticide class applied. Verifiable documentation shall be submitted to the Navy.

3.3 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Upon discovery, notify the Contracting Officer. Stop work in the immediate area of the discovery until directed by the Contracting Officer to resume work. The Government retains ownership and control over historical and archaeological resources.

3.4 SOLID WASTE MANAGEMENT PLAN AND PERMIT

Provide to the Contracting Officer written notification of the quantity of solid waste/debris that is anticipated to be generated by construction. Include in the plan the locations where various types of waste will be disposed or recycled. Include letters of acceptance or as applicable, submit one copy of a State and local solid waste management permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.

3.4.1 Solid Waste Management Report

Monthly, submit a solid waste disposal report to the Contracting Officer. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

The Contractor shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification will include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers.

For each solid waste retained by the Contractor for his own use, the Contractor will submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received will not be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

3.4.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage spent hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, as per environmental law.

In accordance with Federal, State, and Local regulations as well as Department of Defense, Naval Station Great Lakes (NSGL) instruction and NSGL Solid Waste Management Plan (SWMP), recycling is mandatory aboard NSGL. This includes but is not limited to - Construction & Demolition (C&D) debris, ferrous and non-ferrous metals (i.e. steel, copper, aluminum, etc.), paper and cardboard.

All recycling efforts will be coordinated with the Contracting Officer and NSGL Public Works Department Recycling Program Manager (847-688-5395 x211). The PWD Recycling Program will retain all property rights to recyclables generated and will be responsible for directing their disposal.

3.4.2.1 Dumpsters

Equip dumpsters with a secure cover and paint the standard base color. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week or as needed to keep the site free of debris and trash. If necessary, provide 208 liter (55 gallon) trash containers painted the darker base color to collect debris in the construction site area. Locate the trash containers behind the

construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 WASTE DETERMINATION DOCUMENTATION

Complete a Waste Determination form (provided at the pre-construction conference) for all Contractor derived wastes to be generated. Base the waste determination upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). Attach all support documentation to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

3.6 CONTRACTOR HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Contractor Hazardous Material Inventory Log" (found at: <http://www.wbdg.org/ccb/NAVGRAPH/graphoc.pdf>), which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS) to the Contracting Officer at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Contracting Officer.

3.6.1 Disposal Documentation for Hazardous and Regulated Waste

Manifest, pack, ship and dispose of hazardous or toxic waste and universal waste that is generated as a result of construction in accordance with the generating facilities generator status under the Resource Conservation and Recovery Act. Contact the Contracting Officer for the facility RCRA identification number that is to be used on each manifest.

Submit a copy of the applicable EPA and or State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifest must be reviewed, signed, and approved by the Navy before the Contractor may ship waste. To obtain specific disposal instructions the Contractor must coordinate with the Activity environmental office. Refer to Section 3.13.2.4 Hazardous Waste Disposal for point of contact information.

3.7 POLLUTION PREVENTION/HAZARDOUS WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of hazardous waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the Environmental Management Plan. Consult with the activity Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material when preparing this part of the plan. If no written plan exists, obtain information by contacting the Contracting Officer. Describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.8 WHM/HW MATERIALS PROHIBITION

No waste hazardous material or hazardous waste shall be disposed of on government property. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. The government is not responsible for disposal of Contractor's waste material brought on the job site and not required in the performance of this contract.

The intent of this provision is to dispose of that waste identified as waste hazardous material/hazardous waste as defined herein that was generated as part of this contract and existed within the boundary of the Contract limits and not brought in from offsite by the Contractor. Incidental materials used to support the contract including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor.

The list is illustrative rather than inclusive. The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or to the river or conduct waste treatment or disposal on government property without written approval of the Contracting Officer.

3.9 HAZARDOUS MATERIAL MANAGEMENT

No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract.

Include hazardous material control procedures in the Safety Plan. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Submit a MSDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on base.

List of hazardous materials, along with pertinent MSDS, max quantity anticipated to be on site at any one time, etc. shall be submitted to the Contracting Officer PRIOR TO start of project work.

Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, provide the Contracting Officer with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used.

Ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. Ensure that all containers of hazardous materials have NFPA labels or their equivalent. Keep copies of the MSDS for hazardous materials on site at all times and provide them to the Contracting Officer at the end of the project. Certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.10 PETROLEUM PRODUCTS AND REFUELING

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Manage all used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used

oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

3.10.1 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.10.2 Inadvertent Discovery of Petroleum Contaminated Soil or Hazardous Wastes

If petroleum contaminated soil or suspected hazardous waste is found during construction that was not identified in the contract documents, the contractor shall immediately notify the contracting officer. The contractor shall not disturb this material until authorized by the contracting officer.

3.11 FUEL/POL TANKS

Petroleum products and lubricants required to sustain up to 30 days of construction activity may be kept on site. Storage and refilling practices shall comply with 40 CFR Part 112. Secondary containment shall be provided and be no less than 110 percent of the tank volume plus 5 inches of free-board.

If a secondary berm is used for containment then the berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Drips pans are required and the tanks must be covered during inclement weather.

The following are additional requirements for fuel/POL tank:

- a. Temporary fuel storage tanks shall have a total capacity not to exceed 500-gallons.
- b. Temporary storage tanks designated for POLs in excess of 55-gallons shall be approved by the PWD-Environmental Division PRIOR TO FILLING.

3.12 RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum products (including cooking oil and animal grease), lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release.

In the event of any releases of oil and hazardous substances, chemicals, or

gases; immediately (within 15 minutes) notify the Base Fire Department according to Section 3.12.1 below, the activity's Command Duty Officer, and the Contracting Officer. If the Contractor's response is inadequate, the Navy may respond. If this should occur, the Contractor will be required to reimburse the government for spill response assistance and analysis.

Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous (WHM) waste spills. The Contractor shall reimburse the government for all material, equipment, and clothing generated during any spill cleanup. The Contractor shall reimburse the government for all costs incurred including sample analysis materials, equipment, and labor if the government must initiate its own spill cleanup procedures, for Contractor responsible spills, when:

- a. The Contractor has not begun spill cleanup procedure within one hour of spill discovery/occurrence, or
- b. If, in the government's judgment, the Contractor's spill cleanup is not adequately abating life threatening situation and/or is a threat to any body of water or environmentally sensitive areas.

3.12.1 NSGL Release/Spill Contact Information

- a. Spills or chemical releases occurring on Navy property. All spills or chemical releases of petroleum products (including cooking oil and animal grease), hazardous substances, regulated waste, regulated gases or sewage occurring on Navy property shall be immediately reported to:

- (1) Great Lakes Emergency Dispatch Center (847) 688-3333
(HAZMAT, Fire, Police, Ambulance)
- (2) PWD 24-Hour Service Desk (847) 688-4820
- (3) Public Works Department (PWD) (847) 688-6934
Environmental Division x11 OR x12

The Navy will take prompt response action as deemed necessary to contain and otherwise resolve spills or releases with potential impact to environmentally sensitive areas occurring on NSGL including storm sewers; tributary waters of Lake Michigan; creeks/streams; wetlands; critical habitats; and protected or susceptible habitats.

The Navy's designated PWD Environmental Representative is responsible for reporting spill or release incidents occurring on Navy property to Federal, State, and local agencies.

- b. Off-site spills or releases. All spills or releases occurring off-site involving government property is responsibility of the Contactor for reporting to Federal, State and local agencies, and will also be reported to:
 - (1) Navy Project Manager or Contractor Officer
(as identified in the initial project meeting)
 - (2) PWD Environmental Division Director (847) 688-6934
x11 or x12
 - (3) PWD 24-Hour Service Desk (847) 688-4820

(after normal business hours)

The Contractor is responsible for verbal and written notifications required by the federal 40 CFR 355, State, local regulations and Navy Instructions. Spill response will be in accordance with 40 CFR 300 and applicable State and NSGL requirements. Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor will reimburse the Government for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

3.13 CONTROL AND MANAGEMENT OF HAZARDOUS WASTES

3.13.1 Facility Hazardous Waste Generator Status

Naval Station Great Lakes is designated as a Large Quantity Generator. All work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor will comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

3.13.2 Hazardous Waste/Debris Management

Identify all construction activities which will generate hazardous waste/debris. Provide a documented waste determination for all resultant waste streams. Hazardous waste/debris will be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Hazardous waste will also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Management Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities will be identified as being generated by the Government.

Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by activity personnel from the Station Environmental Office. No hazardous waste will be brought onto Government property. Provide to the Contracting Officer a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Contracting Officer immediately.

3.13.2.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor will request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the Contracting Officer providing the following information:

Contract Number _____ Contractor _____

Haz/Waste or

Regulated Waste POC _____ Phone Number _____

Type of Waste _____ Source of Waste _____

Emergency POC _____ Phone Number _____

Location of the Site: _____

(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request. The designated area where waste is being stored shall be barricaded and a sign identifying as follows:

"DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

3.13.2.2 Sampling and Analysis of Hazardous Waste (HW)

a. Waste Sampling

Sample waste in accordance with EPA 530/F-93/004. Each sampled drum or container will be clearly marked with the Contractor's identification number and cross referenced to the chemical analysis performed.

b. Laboratory Analysis

Follow the analytical procedure and methods in accordance with the 40 CFR 261. The Contractor will provide all analytical results and reports performed to the Contracting Officer

c. Analysis Type

Identify waste hazardous material/hazardous waste by analyzing for the following properties as a minimum: ignitability, corrosiveness, total chlorides, BTU value, PCBs, TCLP for heavy metals, and cyanide.

3.13.2.3 Asbestos Certification

Items, components, or materials disturbed by or included in work under this contract do involve asbestos. Other materials in the general area around where work will be performed may contain asbestos. All thermal insulation, in all work areas, should be considered to be asbestos unless positively identified by conspicuous tags or previous laboratory analysis certifying them as asbestos free.

Inadvertent discovery of non-disclosed asbestos that will result in an abatement action requires a change in scope before proceeding. Upon discovery of asbestos containing material not identified in the contract documents, the Contractor shall immediately stop all work that would generate further damage to the material, evacuate the asbestos exposed area, and notify the Contracting Officer for resolution of the situation prior to resuming mal work activities in the affected area.

The Contractor will not remove or perform work on any asbestos containing materials without the prior approval of the Contracting Officer. The Contractor will not engage in any activity, which would remove or damage such materials or cause the generation of fibers from such materials.

Asbestos containing waste shall be managed and disposed of in accordance with applicable environmental law and NSGL procedures. Asbestos containing waste shall be manifested and the manifest provided to the Contracting Officer.

3.13.2.4 Hazardous Waste Disposal

No hazardous, toxic, or universal waste shall be disposed or hazardous material abandoned on government property. And unless otherwise noted in this contract, the government is not responsible for disposal of Contractor generated waste material.

The disposal of incidental materials used to accomplish the work including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive.

The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or water way or conduct waste treatment or disposal on government property without written approval of the Contracting Officer.

Control of stored waste, packaging, sampling, analysis, and disposal will be determined by the details in the contract. The requirements for jobs in the following paragraphs will be used as the guidelines for disposal of any hazardous waste generated.

a. Responsibilities for Contractor's Disposal

Contractor responsibilities include any generation of WHM/HW requiring Contractor disposal of solid waste or liquid.

(1) The Contractor agrees to provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services will include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).

(2) Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.

(3) Obtaining a representative sample of the material generated for each job done to provide waste stream determination.

(4) Analyzing for each sample taken and providing analytical results to the Contracting Officer. Provide two copies of the results.

(5) Determine the DOT proper shipping names for all waste (each container requiring disposal) and will demonstrate how this determination is developed and supported by the sampling and analysis requirements contained herein to the Contracting Officer.

Contractor Disposal Turn-In Requirements

For any waste hazardous materials or hazardous waste generated which requires the Contractor to dispose of, the following conditions must be complied with in order to be acceptable for disposal:

- (1) Drums compatible with waste contents and drums meet DOT requirements for 49 CFR 173 for transportation of materials.
- (2) Drums banded to wooden pallets. No more than three (3) 55 gallon drums to a pallet, or two (2) 85 gallon over packs.
- (3) Band using 1-1/4 inch minimum band on upper third of drum.
- (4) Recovery materials label located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.
- (5) Always have three to five inches of empty space above volume of material. This space is called 'outage'.

Contractor shall dispose of all Government generated waste at a licensed permitted disposal facility. All Disposal Facilities shall complete a NSGL Disposal Facility Environmental Audit Form prior to shipments being scheduled. The Government reserves the right to approve or disapprove all Contractor Disposal Facilities based on compliance issues. Audit forms can be obtained by contacting PWD EV Hazardous Waste Program Manager (HWPM) at (847)-688-6934 x14.

Per Commanding Officer NSGL, Manifesting will be performed by PWD EV. This is required for tracking purposes to maintain regulatory compliance with Federal and State Environmental Protection Agency (EPA) regulations.

Manifesting arrangements shall be scheduled 24 hours in advance, excluding emergencies. Normal service hours are from 0700 to 1130 and 1200 to 1530 hours Monday through Friday. After hour, weekend and holiday manifesting can be requested in writing 48 hours prior to shipment. The Government reserves the right to refuse all after hour, weekend and holiday manifesting at the Government's convenience. The Contractor shall be responsible completing all manifests and waste shipment records for each load of waste to be transported off station and completing all appropriate Land Disposal Notifications. The Contractor shall contact PWD EV HWPM at (847)-688-6934 x14 for review and signature of all manifests. Generator copies of all manifests from disposal facilities, as well as Certificates of Disposal/Recycling shall be returned to PWD EV HWPM within forty-five (45) days of shipment off NSGL. Failure to provide these documents may result in future manifest denial.

Items needed prior to manifests and waste shipment records being signed.

a. Prime Contractor:

1. Laboratory Reports on Waste Streams
2. Profile Sheets
3. Completed Disposal Facility Environmental Audit form from TSDF

b. Transporter:

1. Name, address, phone number, and P.O.C.
2. Copies of transporter permits, and hauler I.D. number
3. Proof of Insurance

c. Disposal Facility (TSDF)

1. Completed Disposal Facility Environmental Audit form

3.13.3 Class I and II ODS Prohibition

Class I and II ODS as defined and identified herein will not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition will be considered to prevail over any other provision, specification, drawing, or referenced documents. Regulations related to the protection of stratosphere ozone may be found in 40 CFR 82.

Heating and air conditioning technicians must be certified through an EPA-approved program. Copies of certifications shall be maintained at the employees' place of business and be carried as a wallet card by the technician, as provided by environmental law. Accidental venting of a refrigerant is a release and shall be reported to the Contracting Officer.

3.13.4 Universal Waste/e-Waste Management

Universal waste including but not limited to some mercury containing building products such florescent lamps, mercury vapor lamps, high pressure sodium lamps, CRTs, batteries, aerosol paint containers, electrical equipment containing PCBs, and consumed electronic devices, shall be managed in accordance with applicable environmental law and installation instructions.

3.14 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning non-particulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.14.1 Dirt and Dust Control Plan

Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

3.15 ABRASIVE BLASTING

3.15.1 Blasting Operations

The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive, agent, paint chips, and other debris in accordance with the requirements specified.

3.15.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations will be managed in accordance with paragraph entitled "Hazardous Waste Management" of this section and with the approved HWMP. Disposal of non-hazardous abrasive blasting debris will be in accordance with paragraph entitled, "Control and Disposal of Solid Wastes".

3.16 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting will not be permitted without written permission from the Contracting Officer, and then only during the designated times. Explosives use at NSGL is not permitted. Confine pile-driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified.

3.17 MERCURY MATERIALS

Mercury / mercury-containing materials are prohibited in the construction of this facility, unless specified otherwise, with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed. Immediately report to the Environmental Office and the Contracting Officer instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Contracting Officer.

Cleanup of a mercury spill shall not be recycled and shall be managed as a hazardous waste for disposal.

PART 4 ENVIRONMENTAL

4.1 NAVAL STATION GREAT LAKES ENVIRONMENTAL SUPPLEMENT

Contractor Environmental Requirements on Naval Station Great Lakes;
Revised: FEB 2015.

-- End of Section --

**CONTRACTOR ENVIRONMENTAL REQUIREMENTS
ON
NAVAL STATION GREAT LAKES**

This document is intended to summarize environmental requirements for contract work specific to Naval Station Great Lakes. Where differences with regulatory requirements or recognized advisory standards occur, the more stringent shall apply.

Naval Station Great Lakes (NSGL), including contractor project work site(s) are subject to Federal, State, and local regulatory inspection to verify compliance with environmental regulations. The Contractor shall cooperate fully with all regulatory representatives which may visit their job site and shall provide immediate notification to the Navy Contracting Officer (NCO). The contractor shall complete, maintain, and make available to the NCO, NSGL designated representative or regulatory agency all documentation relating to environmental compliance as requested.

I. GENERAL REQUIREMENTS

1. The Contractor including representative(s) thereof, is prohibited from initiating contact with local, State, or federal agencies on behalf of NSGL without prior written consent from the NCO. This requirement shall apply to all correspondence, permits, spills, or environmental emergency incidents occurring on NSGL.
2. Permits. Draft copy of all permits or other authorizations shall be submitted to the NSGL Public Works Department Environmental Division (PWD-EV DIV) for approval **prior to submission** to the pertinent regulatory agency. Permits or other regulatory authorizations shall be received by the Contractor with copy provided to the NCO prior to start of field work. Permits or regulatory authorizations include but not limited to – Storm Water Permits, and NSGL Temporary Tank Authorization.
3. Environmental Management System
 - a. Contractor shall perform work consistent with the policy and objectives identified in the Installation’s Environmental Management System (EMS). Work shall be performed in a manner that conforms to objectives, targets, environmental programs and operational controls identified by the NSGL EMS. Contractor shall provide monitoring and measurement information, and management goals in support of NSGL EMS Environmental Aspects and Significant Aspects. In the event an EMS nonconformance or noncompliance associated with the contracted services, tasks or actions occurs, the Contractor shall take corrective and/or preventive actions. In addition, the Contractor shall ensure that its employees are aware of their roles and responsibilities under the NSGL EMS and how these EMS roles and responsibilities affect work performed under the contract.
 - b. Contractor is responsible for ensuring their employees receive applicable environmental training, remain current and knowledgeable on regulatory specific training for the type of work conducted on NSGL. All contract and sub-contract personnel performing tasks that have the potential to cause an impact to the environmental shall be competent on the basis of appropriate education, training or experience.

4. Environmental Compliance Assessment Training and Tracking System

Contractor is required to complete and submit evidence of completion of the Environmental Compliance Assessment Training and Tracking (ECATTS) program. Contractor is required to submit an ECATTS certification of completion for personnel who have completed the required ECATTS training. This training is web-based and can be accessed from any computer with internet access using the following instructions.

- a. Register for NAVFAC ECATTS by logging on to <https://navfac.ecatts.com>.
- b. Obtain registration password from the Navy Contract Representative.

II. CONTROL AND DISPOSAL OF SOLID WASTE

Pick up solid wastes and place in covered containers which are regularly emptied. In accordance with Federal, State, and Local regulations as well as Department of Defense, Naval Station Great Lakes (NSGL) instruction and NSGL Solid Waste Management Plan (SWMP), **recycling is mandatory aboard NSGL**. This includes but is not limited to - Construction & Demolition (C&D) debris, ferrous and non-ferrous metals (i.e. steel, copper, aluminum, etc.), paper and cardboard. Coordinate recycling efforts with the NCO.

III. CONTROL AND DISPOSAL OF HAZARDOUS AND SPECIAL WASTE

1. Hazardous and Special Waste Generation

- a. Hazardous and Special Waste shall be stored in compliance with Federal, State, Local, Navy, and NSGL regulations. The Contractor is responsible for familiarizing themselves with all these requirements. NSGL policies can be obtained on by contacting the NCO.
- b. Prior to any hazardous waste being generated or stored, the Contractor shall contact PWD-EV for the establishment of a Satellite Accumulation Area of a less than 90 Day Accumulation Site. The Contractor shall appoint a hazardous waste point of contact as part of this effort.

2. Hazardous and Special Waste Storage. Store all hazardous and special waste in approved containers in accordance with all Federal, State, and NSGL regulations. Contact PWD-EV DIV for establishment of a Satellite Accumulation Area or a less than 90-Day Accumulation area prior to storing any waste on NSGL.

3. Hazardous and Special Waste Disposal

- a. Contractors shall maintain compliance with Federal, State, Local and NSGL regulations, this includes the NSGL Hazardous Waste Management Plan. Contractor shall dispose of all Government generated waste at a licensed permitted disposal facility. All Disposal Facilities shall complete a NSGL Disposal Facility Environmental Audit Form prior to shipments being scheduled. The Government reserves the right to approve or disapprove all Contractor

Disposal Facilities based on compliance issues. Audit forms can be obtained by contacting PWD-EV Hazardous Waste Program Manager (HWPM) at (847)-688-6934 x14.

- b. Per Commanding Officer of NSGL, manifesting will be performed by PWD-EV DIV. This is required for tracking purposes to maintain regulatory compliance with Federal and State Environmental Protection Agency (EPA) regulations. Manifesting arrangements shall be scheduled 24 hours in advance, excluding emergencies. Normal service hours are from 0700 to 1130 and 1200 to 1530 hours Monday through Friday. After hour, weekend and holiday manifesting can be requested in writing 48 hours prior to shipment. The Government reserves the right to refuse all after hour, weekend and holiday manifesting at the Governments convenience. The Contractor shall be responsible completing all manifests and waste shipment records for each load of waste to be transported off station and completing all appropriate Land Disposal Notifications. The Contractor shall contact PWD-EV DIV HWPM at (847)-688-6934 x14 for review and signature of all manifests. Generator copies of all manifests from disposal facilities, as well as Certificates of Disposal/Recycling shall be returned to PWD-EV DIV HWPM within forty-five (45) days of shipment off NSGL. Failure to provide these documents may result in future manifest denial.
- c. **Items required prior to manifests** and waste shipment records being signed.

1) Prime Contractor

- a) Laboratory reports on waste streams
- b) Profile sheets
- c) Completed **Disposal Facility Environmental Audit** form from TSDF

2) Transporter

- a) Name, address, phone number, and P.O.C.
- b) Copies of transporter permits, and hauler I.D. number
- c) Proof of Insurance

3) Disposal Facility (TSDF)

- a) Completed **Disposal Facility Environmental Audit** form

- 4. Spills and other Environmental Emergencies. Refer to the 'Spill & Chemical Release Procedures' (last page of this document) for subject guidance. For more information, contact the PWD-EV DIV Office at (847) 688-6934 x11 or x20 or the NCO.

IV. BACKFLOW PREVENTERS

Backflow preventers shall have a certificate of full approval from FCCCHR-USC, University of Southern California, attesting that the design, size, and make 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.

V. SITE WORK

1. Hazardous Material Assessment. Building(s) or facility structures, identified for remodeling, renovation or demolition shall be surveyed to determine presence/absence of potentially hazardous materials. The survey shall at minimum include – asbestos (friable and non-friable); lead; lead-containing paints/surface coatings; mercury-containing devices; PCB-containing sources, PCB-containing caulk; and other hazardous building materials that negatively impact the environment or otherwise are regulated. Based on survey results, abatement and disposal plan(s) shall be prepared and submitted to NCO for approval.
2. Open Burning for vegetation control, trash reduction/elimination, or any other purposes is strictly prohibited on NSGL.
3. Storm Water Permit. A National Pollutant Discharge Elimination System (NPDES) permit is required if total disturbed ground area ***equals or exceeds one-acre***. This includes but is not limited to - lay down site, road work, any area(s) dug-up/disturbed for landscaping, and stockpile sites for C&D debris, rock, soil, etc. Submit permit copy to the PWD-EV Director prior to start of the project.
4. Project spoils. Construction and demolition debris, excess dirt, etc. shall be removed from NSGL within 30-days of project completion. Dirt shall be verified **free of contaminants** before its use at alternate site(s) on NSGL. Alternate sites must be approved in advance by the PWD-EV DIV.
5. Fill Soil. Fill soil to be brought on to NSGL must be sampled to confirm compliance with Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) Tier 1 Residential property use scenario for the ingestion, inhalation and migration to groundwater exposure pathways criteria (35 IAC Part 742). If documentation is available from the borrow site vendor, the data can be submitted for a sufficiency review by PWD-Environmental Division. If the borrow site vendor does not have analytical data that documents the condition of the soils, Contractor shall collect representative samples from the proposed borrow area, with a representative from PWD-EV DIV present during sample collection process. Note that all fill soils data provided by the site owner or contractor must be certified by an Illinois Licensed Professional Engineer using Illinois Environmental Protection Agency (IEPA) Form LCP-663 as uncontaminated soil in accordance with the Environmental Protection Act [415 ILCS 5/22.51 (f)(2)(B)]. Regardless of source site use, contractor shall analyze samples for all Target Analyte List and Target Compound List constituents using U.S. Environmental Protection Agency SW846 methods with detection limits appropriate for comparison to the Illinois EPA Tier 1 TACO residential criteria. All laboratory analysis must be performed by an IEPA/NELAC certified laboratory. Sample frequency shall be, at a minimum, one (1) sample per 500 tons soil. No soils shall be brought into NSGL until PWD-EV DIV has reviewed and accepted the analytical data.

A borrow pit or other dirt and gravel sources are unavailable on NSGL.

6. Temporary Fuel / Storage Tanks
 - a. No contractor may bring a tank, which is not a permanently attached part of mobile machinery, on to NSGL property without first developing a SPCC compliance work plan. The SPCC Work Plan (SPCC-WP) must be project site specific, provide details

on how it will ensure compliance with applicable federal, State and local requirements, actions to be taken to prevent a material release or spill, and spill response procedures. At minimum the SPCC-WP shall include a narrative section; site drawings or sketches identifying conveyance(s) to waterways, storm and sanitary sewers, and sensitive habitat; and photos.

- b. Total capacity of temporary fuel/Petroleum Oil Lubricant (POL) storage tanks shall not exceed 500-gallons.
 - c. Storage tanks shall be double-walled and/or with secondary containment as approved by the Navy.
 - d. Temporary storage tanks designated for POLs shall be approved by both PWD-EV DIV and NSGL Fire Department PRIOR TO INITIAL FILLING. Contact the NCO to initiate the approval process.
7. Dewatering
- a. Dewatering, discharge, or any other releases of water or other liquids into storm or sanitary systems is prohibited, unless approved in advance by the PWD-EV DIV.
 - b. Any release or discharge into retention ponds, creeks, tributary waters of Lake Michigan or environmentally sensitive areas is strictly prohibited.

**SPILL & CHEMICAL RELEASE PROCEDURES
NAVAL STATION GREAT LAKES (NSGL)**

1. **Spills or chemical releases occurring on Navy property.** All spills or release of petroleum products (including cooking oil and animal grease), hazardous substances, regulated waste, regulated gases or sewage occurring on Navy property shall be reported immediately to:
 - a. Great Lakes Emergency Dispatch Center 911
(HAZMAT, Fire, Police, Ambulance) (847) 688-3333
 - b. NSGL PWD 24-Hour Service Desk (847) 688-4820
 - c. NSGL Environmental Division (847) 688-6934 x11 or x20
2. The Navy will take prompt response action as deemed necessary to contain and otherwise resolve spills or releases with potential impact to environmentally sensitive areas occurring on NSGL including storm sewers; tributary waters of Lake Michigan; creeks/streams; wetlands; critical habitats; and protected or susceptible habitats.
3. **Off-site spills or releases.** All spills or releases occurring off-site involving government property is responsibility of the Contactor for reporting to federal, State and local agencies, and will be reported to:
 - a. Navy Contracting Official
(as identified in the initial project meeting)
 - b. NSGL PWD 24-Hour Service Desk (847) 688-4820
(after normal business hours)
 - c. PWD Environmental Division (847) 688-6934 x11 or x20
4. **Reporting of spills or releases.** The Navy's designated PWD Environmental Representative is responsible for reporting spill or release incidents occurring on Navy property to Federal, State, and local agencies. Contractor is responsible for reporting all incidents occurring off Navy property.
5. **Liability.** Spills and/or chemical release cleanup, remediation, damage to the environment and other related costs incurred resulting from Contractor actions shall be the responsibility of the Contractor. Such actions taken by the Navy or its designated responder(s) as deemed appropriate and necessary, shall be at the expense of the responsible Contractor.

SECTION 01 57 19.01 20

SUPPLEMENTAL TEMPORARY ENVIRONMENTAL CONTROLS

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. If state or local references are not provided here, refer to Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS for appropriate references.

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

40 CFR 82

Protection of Stratospheric Ozone

WASHINGTON STATE ADMINISTRATIVE CODE (WAC)

WAC-173-303

Washington Dangerous Waste Regulations

1.2 DEFINITIONS

1.2.1 Contractor-Generated Waste

Material that is Contractor originated, brought on site by the Contractor, and becomes a waste during construction at or on government property.

1.2.2 Dangerous Waste

Waste defined as dangerous waste per WAC-173-303. This includes, but is not limited to, hazardous waste, extremely hazardous waste and state-only dangerous waste.

1.2.3 Encountered Waste

Material that is of government origin which becomes a waste during construction at or on government property. This term includes both foreseen and unforeseen government wastes discovered at the worksite.

1.2.4 Firewood

Raw woody material cut into short lengths and burned to produce energy.

1.2.5 Fugitive Dust

Particulate matter or any visible air contaminant (smoke, dust, or fume) other than uncombined water that is not collected by a capture system and emitted from a stack, but is released to the atmosphere at the point of generation.

1.2.6 Ozone Depleting Substance (ODS) Substitute

Any chemical or product, whether existing or new, that is used by any person as an EPA approved replacement for a class I or II ozone-depleting substance in a given refrigeration or air-conditioning end-use.

1.2.7 Refrigerant

Any substance consisting in part or whole of a class I or class II ozone-depleting substance, or an ozone depleting substance substitute that is used for heat transfer purposes and provides a cooling effect.

1.2.8 Refuse

Includes, but is not limited to garbage, rubbish, trash, some soils, and non-painted demolition and construction debris. Refuse shall be designated by the government. When designated "refuse," the government has determined the waste is not "Dangerous Waste."

1.2.9 Sewage

Liquid wastes designated by the government as "domestic sanitary sewage" and normally discharged through domestic sanitary sewage systems. Liquids designated as "sewage" include human body wastes, and wastewater from sinks, showers, laundries, dishwashers, and garbage disposals when these liquids use only chemicals approved by the Government for discharge into the sanitary sewer.

1.2.10 Spill Event

A spill is any release of oil or hazardous substances to the water or ground that is not controlled or permitted. This includes any spilling, leaking, pumping, emitting, discharging, injecting, escaping, leaching, disposing, or dumping of liquid or solid material that is not authorized in writing by the Contracting Officer. Emergency and non-emergency spills are defined as follows:

1.2.10.1 Emergency Spill Event

An emergency spill event is any release of a known or unknown material or hazardous substance that poses an immediate threat to human health or the environment to the air, soil, or water and is not classified as a non-emergency spill event. All unpermitted or uncontrolled releases on land, to air or discharges to any waterways or outside Navy properties, are classified as emergency spill events.

1.2.10.2 Non-emergency Spill Event

A non-emergency spill event is a discharge of a known material or any hazardous substance that does not pose an immediate threat to human health or the environment, can be cleaned up as part of normal housekeeping by the personnel who discovered the spill, and is not released on the soil or into any waterway inlet (e.g., storm drain) or outside Navy property boundaries.

1.2.11 Timber, Merchantable

Any raw material yielded by a forest that is of a size, quality and condition suitable for marketing under given economic conditions, even if so situated as not to be immediately accessible for logging.

1.2.12 Landfill-Controlled Waste

Waste containing harmful substances but not designated as dangerous per WAC-173-303 that are screened by a receiving facility to ensure that it meets the requirements of their operating permit. Examples; petroleum

contaminated soil, abrasive blast grit, street or dry-dock sweepings, treated wood, oily debris, and waste containing free liquids as determined by the Paint Filter Liquids Test method 9095.

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

Excavation Permits; G

Dirt and Control Plan; G

Storage Form; G

PSCAA Non-Road Notification Form; G

Notice of Construction; G

Contractor's Operation and Maintenance (O & M) Plan

Project Report

Waste Originator Training Certification; G

SD-03 Product Data

HVAC&R equipment; G

1.4 MID-ATLANTIC

1.4.1 Illinois

a. Great Lakes

1.4.1.1 Definition and Disposal Requirements of Empty Paint Cans

Paint Cans: Paint cans that are empty (free of liquids and contains less than 1 inch of dried material) of paints, solvents, thinners and adhesives may be disposed of in dumpsters.

Metal paint cans that meet the empty standard can be placed in dumpsters marked "metal only"; plastic cans may be placed in solid waste dumpsters. Manage paint cans with liquid or more than 1 inch of solidified oil-based paint as a hazardous waste and properly label. Manage paint cans with excess water-based paint as non-hazardous waste. Contact NAVFAC MIDLANT Environmental Services for management requirements.

1.4.1.2 Erosion and Sediment Control Measures and Stormwater Management

1.4.1.2.1 Construction Dewatering

There must be no release of construction discharge water to the stormwater system or into State waters without prior authorization in writing from the Environmental Division. Construction Dewatering must not be discharged to the sanitary sewer system. The discharge of hazardous substances is not permitted under any circumstances.

Construction site stormwater runoff must be treated through the use of proper erosion control measures or stormwater management practices prior to release from the construction site. Pollutants, including but not limited to chemicals, fuels, lubricants, sewage, paints, sedimentation, and other harmful materials must not be discharged into or alongside any River, Stream, or Impoundment, or into any channels leading to them. Contractors must implement appropriate erosion and sediment control measures to all disturbed areas or bare soils to prevent unauthorized offsite sedimentation. Denuded portions of a project which are at final grade or where work has temporarily ceased must have stabilization measures applied within 7 days.

1.4.1.3 Hazardous Waste Requirements for Illinois Installations:

1.4.1.3.1 Hazardous and Universal Waste Generation

Hazardous Waste Minimization and Disposal Guide is attached.

1.4.1.3.2 Excavation

If soil is to be reused on site, sampling is not required unless otherwise directed. Excavated soil may be re-used within the construction site with no testing necessary. Soil may be stockpiled until the end of the project, then re-used as much as possible prior to sampling/analysis for residual soil to be disposed of. Store all in a manner that prevents rain from infiltrating the soil matrix and preventing any runoff into the surrounding soil or pavement (e.g. store the soil on top of plastic sheets and covered with plastic sheets or in lined, covered dumpsters). If the soil is going to be relocated or disposed outside the construction site, sampling and analysis is required. Contact the installation HW Program Manager prior to disposal to determine the appropriate sampling/ test parameters. Soil disposal requirements will depend on test results.

Sub-surface archaeological resources can be encountered unexpectedly. During any soil disturbing activities, should historic or prehistoric artifacts, buried features, or structural foundations be discovered, halt the action and contact the NAVFAC MIDLANT Regional Historic Preservation Officer and the Contracting Officer immediately.

1.4.1.3.3 Painting and Paint Removal

Air drying cans for disposal is allowed only if liquid residue is less than 1 inch; keeping all paint or solvent containers closed and secured when not adding or removing material or waste. Waste paint chips/debris must be collected and sampled to determine proper disposal method. Contact the EV HW Program Manager for sampling requirements. If waste paint is determined to be hazardous, waste must be managed as hazardous and an appropriate accumulation area must be established. Contact the EV HW Program Manager for site setup.

Implement BMPs to contain dust and debris emissions to the air.

1.4.1.3.4 Dumpsters

Keep cover closed at all times, except when being loaded with trash and debris. Empty site dumpsters at least once a week or as needed to keep the site free of debris and trash. Label trash containers to appropriately describe the contents.

1.4.1.4 Air Requirements:

1.4.1.4.1 Concrete Crushing

Secure an air permit for the crusher from the regulatory agency where the equipment is home-based. Provide a copy of the permit to the environmental office (Air Manager) through the Contracting Officer at least 30 days prior to bringing crusher on-site.

Utilize Best Management Practices (BMPs) (such as water suppression) during crushing operations to minimize dust and debris emissions to the air. Consider other environmental program requirements such as Clean Water Act (CWA) requirements when making decisions in regard to BMPs.

1.4.1.4.2 Painting

Control volatile organic compound emissions by keeping all paint, solvent, and waste containers closed/secured except when adding or removing material or waste. Control air emissions via air drying cans for disposal only if liquid residue is less than 1 inch.

Control particulate matter emissions by using containment such as shrouds to contain overspray during spraying operations.

1.4.1.4.3 Paint Removal

Control dust, abrasive agent, paint chips, and other debris during abrasive blasting or similar operations that could emit dust/debris. Containment could include application of water and use of shrouding/containment. Consider other environmental program requirements such as Clean Water Act (CWA) requirements when making decisions in regard to BMPs.

1.4.1.4.4 Heating Ventilation Air Condition and Refrigeration (HVAC&R) Work

HVAC&R work must be performed by EPA certified technicians, using recycling/recovery equipment that meets EPA standards, and performed in accordance with EPA regulations governing Ozone Depleting Substances (40 CFR 82). Copies of certifications must be maintained at the employees' place of business and be carried as a wallet card by the technician, as provided by environmental law. Accidental venting of a refrigerant is a release and must be reported to the environmental office (Air Manager) through the Contracting Officer.

Do not use Class I and II ODS as defined in 40 CFR 82 in performance of this contract, nor provide as part of the equipment. This prohibition prevails over any other provision, specification, drawing, or referenced documents. Regulations related to the protection of stratosphere ozone may be found in 40 CFR 82. Provide product data and details for new or replacement HVAC&R equipment to the Environmental Office (Air Manager)

through the Contracting Officer. Data to be reported include: equipment type, manufacturer, model number, serial number, refrigerant type, tons cooling capacity, and normal pounds refrigerant charge.

1.4.1.4.5 Preconstruction Air Permits

Air permits may be required prior to construction or installation of new, replacement, or relocated air emission producing equipment (e.g. stationary internal combustion engines (fuel fired generators, compressors, pumps); fuel fired boilers, furnaces, heaters; paint booths, blast booths, woodworking shops, gas stations, fuel dispensing tanks, parts washers). Notification to the EV Air Program Manager through the Contracting Officer must be made at least 6 months prior to bringing equipment, assembled or unassembled, onto the Installation, so that air permits can be secured. Necessary permitting time must be considered in regard to construction activities. All Clean Air Act (CAA) permits must be obtained prior to bringing equipment, assembled or unassembled, onto the Installation.

Permits will be provided by the Government.

1.4.1.5 Spill Response and Reporting

Spills include any spilling, leaking, pumping, emitting, discharging, injecting, escaping, leaching, disposing, or dumping of liquid or solid material that is not authorized in writing by the Contracting Officer. Report all Spills to the appropriate installation ECC immediately upon discovery. The Responsible party will fund all clean up and disposal costs.

After notification of installation ECC, notify your Navy point of contact. Refer to the Activity Hazardous Material Reutilization, Hazardous Waste Minimization and Disposal Guide Appendix 3 for spill contact procedures. Refer to "Table 1 - Spill Reporting Contact Numbers" for the appropriate point of contact.

Table 1 - Spill Reporting Contact Numbers			
INSTALLATION	Emergency Contact	CDO	Environmental
NWS Yorktown Cheatham Annex Yorktown Fuels	757-887-4911 (ECC)	757-268-6250	757-887-4086 757-887-4881 757-636-4494 757-887-4095
Naval Air Station Oceana Dam Neck Annex Naval Auxiliary Landing Field Fentress	911 (ECC)	757-433-2366	757-433-3435 757-433-3437 757-433-3439 757-433-2131 757-328-4673

Table 1 - Spill Reporting Contact Numbers			
INSTALLATION	Emergency Contact	CDO	Environmental
Dare County Bombing Range	911 (Local Emergency Services)	757-433-2366	757-421-8114 757-433-3435 757-433-3437 757-433-2131 after hours: 757-636-4256 or 757-943-0991
Defense Fuel Support Point Craney Island (see DFSP Craney	757-396-3333 (NNSY ECC)	757-322-2365	757-635-5740 757-341-0523
Joint Expeditionary Base Little Creek	757-462-4444 (ECC)	757-462-7385 or 757-438-3930	757-462-5350 757-462-5361 757-462-5355 757-462-5356 757-462-5353
Joint Expeditionary Base Fort Story	757-422-7141 (ECC)	757-462-7385 or 757-438-3930	757-462-5350 757-462-5361 757-462-5355 757-462-5356 757-422-7344 ext 225
Naval Station Norfolk	757-444-3333 (ECC)	757-438-3860	757-341-0523 757-341-0516
Naval Support Activity Hampton	757-444-3333 (ECC)	757-438-3402	757-836-1862
Norfolk Naval Shipyard St. Juliens Creek Annex Scott Center Annex Southgate Annex	757-396-3333 (NNSY ECC)	757-396-3222	757-396-8270
St. Helena Annex	911 (Local Emergency	757-396-3222	757-396-8270
Naval Support Activity Northwest	911 (Chesapeake Emergency Services)	757-438-3503	757-421-8114 757-650-7286 after hours: 757-636-4256 or 757-943-0991
ROTHR New Kent	757-887-4911 (ECC)	757-268-6250	757-887-4086 or 757-887-4881
Naval Medical Center Portsmouth	757-396-3333	757-396-3222	757-396-8270

Renovate SWOSU Fire Fighter Trainer (Building 510)
Naval Station Great Lakes, Great Lakes, IL

WON 1310337

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

2013 HAZARDOUS MATERIALS REUTILIZATION, HAZARDOUS WASTE MINIMIZATION AND DISPOSAL GUIDE



The purpose of this guide is to communicate regulatory requirements and management procedures relevant to the utilization of hazardous material, and minimization and disposal of hazardous waste. It is your responsibility to notify the hazardous waste Media Manager of new wastes requiring characterization. The hazardous waste Media Manager should be notified before the waste is generated if at all possible.

Implementing effective environmental management, by incorporating these procedures, shows our commitment to environmental stewardship through regulatory compliance, pollution prevention, and continual improvement.

Understanding how your job impacts the environment and what regulatory requirements apply provides for a reduction in environmental impacts, ensures environmental compliance through enhanced awareness and is essential in maintaining our Environmental Management System (EMS).

Annual training is required for all personnel managing hazardous waste and hazardous materials. Web-based training is available via ECATTS at <https://navfac.ecatts.com>.

For questions regarding hazardous waste management or hazardous material use, please see Appendix 1 for Hazardous Waste Media Manager contacts for your installation.

This guide is for the following Naval installations in the Hampton Roads area ONLY.



Naval Station Norfolk, NSA Hampton Roads, Lafayette River Annex, Craney Island, Naval Weapons Station Yorktown, Yorktown Fuels, Cheatham Annex, New Kent ROTH, Joint Expeditionary Base Little Creek-Fort Story, St. Julien's Creek Annex, South Gate Annex, Scott Center Annex, Naval Medical Center Portsmouth, Naval Air Station Oceana, Dam Neck Annex, NSA Northwest Annex, Fentress Air Field, Dare County Bombing Range

DOCUMENT TITLE: Hazardous Materials Minimization, Hazardous Waste Reutilization and Disposal Guide				
CONTENTS TABLE OF CONTENTS BEGINS ON PAGE IV				
PREPARED BY: Hazardous Waste Program Managers			APPROVED BY: EQMB	
REV. NO.	EFFECTIVE DATE	DESCRIPTION OF REVISION	APPROVAL	
			SIGNATURE	DATE
A	2005	ORIGINAL ISSUE		
B	Dec. '07	Updated POC, aerosol and oil filter information; added Universal Waste Guidance, changed ECAP Tech to CHRIMP Tech and updated inspection checklists		
C	March '08	Updated POC information and phone numbers, bio-hazardous waste information	<i>Lee Hay</i>	25 Nov 08
D	Oct. '09	Updated compressed gas cylinder, bio-hazardous waste, Universal Waste, and POC information. Updated inspection checklists and included Joint Expeditionary Base Fort Story installation in guidance.	<i>Lee Hay</i>	3 Nov 09
E	Aug. 10	Updated guidance throughout. Material Turn-In - Waste Audiences	<i>Lee Hay</i>	19 Aug 10
F	March 12	Updated guidance throughout. Streamlined format and waste SOPs.	<i>Lee Hay</i>	26 Mar 12
G	Feb 12	Updated POCs, added guidance on CER, THF.	<i>Lee Hay</i>	20 Feb 13

FORM EMS-2 (REV. B)

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GUIDE INTRODUCTION

This guide applies to naval installations in the Hampton Roads area and was developed in accordance with applicable Navy instructions (Ref. A) and Federal and State laws. It is divided into four (4) main sections:

- I. Waste Minimization Information
- II. Hazardous Material Reutilization Information
- III. Hazardous Waste Management and Disposal Information
- IV. Management of Specific Materials/Wastes

The first three sections of this guide will provide you information on how to best manage your excess Hazardous Material (HM) or the Hazardous Waste (HW) that you may generate.

The **Waste Minimization Information** section will provide tips and information on how to generate less waste. Reducing waste generation is the most cost-effective way to manage waste. By not creating waste, an activity reduces its environmental footprint, protects the environment for future generations, and helps maintain the public image of the Navy as good environmental stewards.

The **Hazardous Material Reutilization Information** section provides various options other than disposal. Information and procedures are provided on how to return HM to Hazardous Material Minimization Centers (HAZMINCENs), shelf-life extension procedures, various recycling and/or cross-decking efforts, and material transfer procedures to DLA Disposition Services for public resale.

The **Hazardous Waste Management and Disposal Information** section of this guide details the procedures to be followed to dispose of an item. HW disposal is the most costly and regulated method of managing expired or unneeded HM. The cost of disposal is often more than the purchase cost of the material, thus every effort should be made to avoid generation of a hazardous waste. The options in Sections I and II should be explored prior to HW disposal.

Section IV of this guide, **Management of Specific Materials/Wastes**, provides instructions for the management of specific HW that are generated most frequently in the Hampton Roads Region.

Useful contact information is listed at the beginning of each section. For a full list of points of contact related to this guide, see Appendix 1.

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- APPENDIX 9: CALL 2 RECYCLE GUIDELINES

REFERENCES

- A. OPNAV 5090.1C CHG. 1 CHAPTER 15 "HAZARDOUS WASTE MANAGEMENT ASHORE,"
[HTTP://WWW.NMCPHC.MED.NAVY.MIL/ENVIRONMENTAL_HEALTH/OPNAVINST_5090_1C.ASPX.](http://www.nmcphe.med.navy.mil/environmental_health/opnavinst_5090_1c.aspx)
- B. OPNAV 5100.23G, CHAPTER 7, "HAZARDOUS MATERIAL CONTROL AND MANAGEMENT"
[HTTP://DONI.DAPS.DLA.MIL/DIRECTIVES/05000%20GENERAL%20MANAGEMENT%20SECURITY%20AND%20SAFETY%20SERVICES/05-100%20SAFETY%20AND%20OCCUPATIONAL%20HEALTH%20SERVICES/5100.23G%20W%20CH-1.PDF](http://doni.daps.dla.mil/directives/05000%20GENERAL%20MANAGEMENT%20SECURITY%20AND%20SAFETY%20SERVICES/05-100%20SAFETY%20AND%20OCCUPATIONAL%20HEALTH%20SERVICES/5100.23G%20W%20CH-1.PDF)
- C. JOINT SERVICES POLLUTION PREVENTION AND SUSTAINABILITY LIBRARY
[HTTP://WWW.P2SUSTAINABILITYLIBRARY.MIL/QUERYNONAV.ASPX?TOPIC=244](http://www.p2sustainabilitylibrary.mil/querynonav.aspx?topic=244)
- D. DOD SHELF LIFE PROGRAM, [HTTPS://WWW.SHEFLIFE.HQ.DLA.MIL/POLICY_DOD4140_27.ASPX](https://www.shelflife.hq.dla.mil/policy_dod4140_27.aspx)
- E. 40 CFR PART 261 "IDENTIFICATION AND LISTING OF HAZARDOUS WASTE"

I. WASTE MINIMIZATION INFORMATION

A) **USEFUL CONTACT INFORMATION** - see Appendix 1.

B) **WORK PRACTICES AND MATERIAL SUBSTITUTION** - In an effort to reduce the generation of Hazardous Waste (HW), users of Hazardous Material (HM) should incorporate CHRIMP and the following business practices into their everyday work.

PLEASE NOTE!

When applicable, relevant technical manual guidance must be the prevailing factor in any decision to use a substitute for a hazardous material.

- **HM control and management:** Activities should adopt procedures to manage, minimize, and control the acquisition of HM. This is an excellent way to prevent waste, fraud and abuse as well as to ensure that HM is utilized prior to expiration. Having the correct amount of HM for a job and using the HM before it expires will save time and money in reduced HW. Please refer to Ref. B for specific guidance on HM Storage.
- **HM procurement through the Re-Use store:** HM may be available for no cost at the Reuse Store. Instead of bringing more HM (that must be managed in accordance with Navy guidelines) on Navy property, reuse another work center's overage. The Reuse Store is primarily located at NS Norfolk Building X-218. The Navy ERP (N-ERP) website provides Asset Visibility by Installation and Region and allows customers to see if material are available at their local HAZMINCEN for free issue or for purchase. N-ERP is a CAC enabled website so CAC certificate is required but a login and password may not be required to check material availability.
- **HAZMINCEN Locations:**
 - NS Norfolk: Building LF-50 (Building X-218 Reuse Store)
 - NAS Oceana: Building 826
 - Fort Eustis Building 1205

Note: NS Norfolk customers are encouraged to contact Building X-218 to confirm material availability of Reuse/SHIPR material (walk-ins are welcome).

- **Self-Help:** When working on a project, ensure that all appropriate work permits are obtained prior to starting your project. You can get free paint and other building materials for small jobs to spruce up your command at your base's Self-Help Center.
- **Process changes:** Is there a way to conduct the work without using a HM or creating a HW? The Navy is constantly testing safer, more environmentally friendly chemicals and processes. For the latest developments, call your P2 Media Manager or Naval Air Technical Data & Engineering Service Command (NATEC) representative (<https://mynatec.navair.navy.mil>).
- **Solvents:** Can generate large volumes of HW with stringent management requirements and costly disposal. Consider replacing solvents containing MEK, xylene, and toluene with less toxic materials such as EP-921. Clean parts requiring high purity solvents with fresh solvent and use the solvent to clean other dirtier parts before replacing.

- **Material substitution:** Is there a less hazardous or more “environmental friendly” material that can be substituted for the HM? Green procurement is the purchase of **approved** environmentally preferable products and services in accordance with one or more of the established Federal “green” procurement preference programs.
- **Green Products:** Consider green products and/or services as the first choice in all procurement, including service contracts. DoN activities must purchase green products when planning to purchase products and/or services in the following categories (note that this list is not all inclusive):
 - Office products (including electronic equipment) and printing services
 - Fleet maintenance products
 - Building construction, renovation, maintenance, and janitorial products
 - Traffic control
 - Parks and recreation and landscaping services
 - Appliances and lighting

Federal green procurement preference programs

Products manufactured from recovered materials	http://www.epa.gov/cpg
Environmentally preferable products	http://www.epa.gov/epp
Energy efficient products	http://www.eere.energy.gov/femp/technologies/ee_products.cfm
Bio-based products	http://www.biopreferred.gov/?SMSESSION=NO
EPA’s Design for the Environment Safer Product Labeling Program	http://epa.gov/dfe/pubs/projects/formulat/formpart.html
Alternative fuels and fuel efficient vehicles	http://www.eere.energy.gov/topics/vehicles.html

To support the Green Procurement Program(GPP), Contracting and Purchasing personnel must take GPP training through Navy Schools, Defense Acquisition University, DLA’s Buying Green Workshop, NAVSUP’S DON Consolidated Card Program Management Division (CCPMD) Website (<https://www.navsup.navy.mil/ccpmd>), and NAVFAC Environmental Compliance, Assessment Training and Tracking System(<https://navfac.ecatts.com/>).

Defense Logistics Agency (DLA) has developed an environmental products catalog that can be found at <http://www.dscr.dla.mil/userweb/dscrld/epa/epinfo.htm>. This catalog gives brief equipment descriptions, national stock numbers (NSNs), and environmental benefits of products.

- **Recycle/Reuse:** Instead of disposing of an item, is there another use for this material within your command? Can the item be recycled through the Regional Recycling Program? If the item is not currently accepted through the Program, should it be?

The P2 media managers can assist in waste reduction efforts by identifying pollution prevention equipment and conducting process evaluations. Additional information and resources are available at Ref. C the Joint Services P2 library.

C) CONSOLIDATED HAZARDOUS MATERIAL REUTILIZATION AND INVENTORY MANAGEMENT PROGRAM (CHRIMP)

In accordance with the Chief of Naval Operations (CNO) message dated January 3, 2003, all ships and shore installations are required to fully implement CHRIMP. All commands (ship or shore) can return excess and unused HM to the Fleet Industrial Supply Center (FISC) HAZMINCENs (see section I.B for HAZMINCEN locations). For more information please see section II.B of this guide.

D) REGIONAL SOLID WASTE AND RECYCLING

- Information on Naval Facilities Engineering Command Mid-Atlantic (NAVFAC MIDLANT) Regional Resource, Recovery, and Recycling Program and other recycling programs can be obtained by contacting the Mid-Atlantic Regional Recycling Program (RRP) contact listed in Appendix 1.
- The Regional Recycling Centers are located at:
 - NS Norfolk: Building Z-309
 - NAS Oceana & Dam Neck Annex: Oceana Building 934
 - Joint Expeditionary Base Little Creek-Fort Story West: FS West Building 3661
 - NWS Yorktown and Cheatham Annex: Yorktown Shed 6
- To continue recycling in a safe and environmentally responsible manner, we need your help when preparing for delivery to the Recycling Center. It is important that you have a clear understanding of which materials are acceptable and which are not. To help you in preparing your loads and to ensure they will be accepted at the Recycling Center, the following information is provided. This does not encompass all possible items, rather it is a general list of most frequently delivered items.
 - Hours of operation are Monday-Friday 0700-1500 (no appointment necessary)
 - DD1348 required
 - No after-hours drop-off on certain turn-ins
 - For additional information contact the RRP

NOTE!

Items collected and received may change from time to time based on the commodities markets. If you find or have items not included below and you are uncertain about them, please call your installation Recycling Center.

- 1) Examples of materials that are recycled
 - a. **Mixed stream office recycling:** All office recycling is accomplished through a mixed stream recycling method utilizing 90 gallon blue recycling bins. These bins are located in various areas in all buildings on the installation. The bins are picked up on prescheduled days and on call emergencies. All material is also accepted at all the Recycling Centers. The following materials are accepted in the blue recycling bins: white and colored paper; newspaper; phone books; plastic bottles; small cardboard containers; file folders; magazines; aluminum cans; envelopes.
 - b. **Cardboard:** Flat cardboard may be placed in dumpsters marked "Cardboard Only". Cardboard is accepted at all recycling centers.
 - c. **Metal Items:** Metal items may be placed in dumpsters marked "Metal Only". Metal items are also accepted at the Recycling Centers. Units with special needs should contact their Recycling Center, located on their installation.

- d. **Dock (Mooring) Lines:** All lines can be coiled, and secured to a pallet when dropped off at the Recycling Centers.
- e. **Drums (Metal or Plastic):** Contact your Recycling Center before turning in empty drums/containers for special instructions. Drums containing one inch or more liquid will be rejected.
- f. **Empty Compressed Gas Cylinders:** Prior to receipt of the cylinders the needle valve must be removed and the cylinder cut in half, or cut wide enough to indicate that the cylinder cannot be under pressure again.
- g. **Appliances:**
- Useable appliances such as air conditioning and refrigeration (A/C&R) units, washers, and dryers may be turned in to DLA Distribution Services for possible resale. Contact DLA for guidance (see section II.E for details).
 - Unusable washers and dryers may be recycled.
 - Unusable AC&R units (e.g. refrigerators, air conditioners, water fountains, freezers, or any item that normally contains refrigerant), may be recycled IF:
 - (1) All remaining refrigerant has been removed and unit is certified “refrigerant-free” by a certified technician. Contact NAVFAC-MIDLANT maintenance or your FMS to coordinate this service. At NS Norfolk, this service is provided by self-help and coordinated through your FMS.
 - (2) The run capacitors and start capacitors have been removed (a/c units).
 - (3) The compressors have been removed (refrigerators and a/c units)
 - (4) All oils have been removed and properly disposed of.
- h. **Motor Vehicle Parts:** Units must deliver their parts in government vehicles.
- Engine blocks must be drained* of all fluids; oil filters and pans must be removed.
 - Transmissions must be open and drained* of all fluids.
 - Rear ends must be drained* and the plate removed.
- *drained oils can be turned in by calling the Environmental Services Desk (ESD)*
- i. **Batteries:** recyclable lead acid batteries are accepted provided they meet the following restrictions:
- Only **lead acid** batteries that are **not metal encased**. In special cases metal encased lead acid batteries may be taken by the Recycling Program depending on market conditions- contact your installation recycling manager for clarification.
 - Batteries must be in good condition with caps securely in place. Batteries that are cracked or have missing caps must be disposed of as HW- contact the NAVFAC MIDLANT Environmental Services Desk (ESD) for disposal.
 - The customer must deliver the batteries to the Recycling Centers in a government owned vehicle.
 - All batteries not meeting the requirements listed above are to be turned over for disposal to NAVFAC-MIDLANT ESD.
- j. **Toner Cartridges:** Cartridges must be placed in a clear plastic bag or in a box and sealed to prevent powder from spilling; place beside the 90 gallon Blue Recycling container for pickup.
- k. **Expendable Brass Casings:** All MPPEH residue (i.e., inert small arms spent brass casings .50 caliber or smaller), lead, and mixed metals or shrapnel will be turned-in to the local QRP via the NAVFAC MIDLANT QRP Hampton Roads Operations Manager or QRP MPPEH Supervisor. Please refer to

COMNAVREGMIDLANTINST 5090.6 Appendix D (Installation Explosive Hazardous Waste Management Plan) for a full list of requirements regarding the management of MPPEH residue. Requirements for managing expended brass casings include but are NOT limited to the following:

- Small arms cartridge cases should be separated by metal types (i.e., steel, chrome, aluminum, brass). Under no circumstances should large .50 caliber and small .22 caliber, be mixed or co-mingled with any other size cartridge casings in the same container. They must be packed separately. Range residue, other than small arms cases, i.e. shrapnel or lead, will be placed in its own container and clearly marked.
- Expended brass casings must be managed in sealed and labeled 55-gallon drums in a facility or area where the drums are protected from the elements (i.e. rain, snow, etc.). At no time before or after certification and verification should water be allowed to enter the drums.
- Drums must be accompanied by a DD 1348-1A that includes the Generating Command/Range, Quantity, Date, Names and Signatures of personnel certifying and verifying that all shell casing are inert. (NOTE: Each shell casing requires a two-person 100% visible inspection that the shell casing is inert. QRP has been instructed to turn away expended brass that does not contain the appropriate paperwork with authorized dual signatures and certification statement.)

2) Some materials that are **rejected** (***questions contact Recycling Manager or See Section IV***)

- a. Any material containing hazardous or toxic substances, materials or waste
- b. Gasoline, diesel fuel, propane or other petroleum products
- c. Pressurized Cylinders and Fire Extinguishers
- d. Asbestos of any kind (such as pipe insulation or surfacing materials)
- e. Wire rope or cable in lengths greater than 6 feet
- f. A/C&R units that are NOT certified CFC free or have run/start capacitors
- g. PCB containing materials such as capacitors, ballast, and transformers
- h. Fluorescent or mercury vapor lights and related fixtures
- i. Radioactive materials or containers
- j. Free flowing fluids of any kind
- k. Dirt, debris, trash or waste of any kind
- l. Food or food byproducts
- m. Bedding or clothing products
- n. Cooking oil or grease
- o. Wood (accepted only at selected sites)
- p. Yard waste
- q. Tires (accepted only at selected sites)
- r. Rags/Shop Towels
- s. Lawn or plastic furniture
- t. Speedy-Dry or absorbent materials or chemicals
- u. Medical waste of any kind

II. HAZARDOUS MATERIAL REUTILIZATION INFORMATION

If you have excess or unused hazardous material, it is important that the following alternatives to disposal be considered. Disposal of HM should be utilized as a last resort.

- Returning to supply (HAZMINCENs) for credit or reuse
- Extending shelf-life
- Crossdecking use
- Turning in to DLA Disposition Services Norfolk (formerly DRMO)

A) **USEFUL CONTACT INFORMATION** - see Appendix 1.

▪ **HAZMINCEN Locations:**

- NS Norfolk: Building LF-50 (Building X-218 Reuse Store)
- NAS Oceana: Building 826
- Fort Eustis Building 1205

B) **RETURNING HAZARDOUS MATERIALS (HM) TO SUPPLY (HAZMINCENs)**

If you purchase HM and determine the item is not needed, it can be returned to the HAZMINCENs for a refund or for reuse. Refunds are provided for new/unopened HM purchased from the HAZMINCEN. Please note that refunds are not given on special (non-stock) orders. FISC also offers a Reuse Store located at Naval Station Norfolk, Building X-218. The Reuse Store will accept and issue excess or unused HM **free of charge**. HM destined for the Reuse Store can be turned in at any of the FISC HAZMINCENs across the region. To return excess/unused material, the item must meet the following conditions:

- 1) Material must be accompanied by 4 (four) copies of completed DD Form 1348-1A or DD Form 1348-1 created by HICSWIN (see Appendix 2 for instructions).
- 2) Material must be unopened and have original labels. (Partially used material may be considered for cross-decking or turned in for disposal.)
- 3) Container must be undamaged or minimally damaged (i.e. slightly dented) and have minimal rusting.
- 4) FISC will accept Type I that has not expired and Type II shelf life material that has not been extended more than two times (see section II.C). Contact DLA Disposition Services for items that have been extended more than two times.

IF YOU HAVE MORE THAN 4 PALLETS OF EXCESS HM TO TURN-IN (SHIPS)

- Coordinate the offload/turn-in through the assigned CHRIMP Technician **24 hours** in advance of desired off-load.
- All HM leaving ships must be processed through the HAZMINCEN via HICSWIN.
- The offload procedure is as follows:
 - PLANNING:** Once informed of a request for an offload, the designated ship representative will contact the CHRIMP office.
 - REVIEWING:** The CHRIMP technician will examine the items to determine what is still usable and what is excess used material.
 - TRACKING:** Data management depends on the type of excess stock. HICSWIN will be the software used for all reuse material offloaded; R-Supply will be used for all BP-28 (Deep Stock) material offloaded. These programs have the capability to print four (4) copies of DD Form 1348-1A or 1348-1, "Material Turn-In." The 1348-

1A or 1348-1 must have the ECAP acronym stamped on the document prior to turn-in.

DISPOSAL: should the HM require disposal, contact NAVFAC MIDLANT ESD services to arrange for pick-up by calling 757-341-0412/0460.

- Additional information regarding disposal procedures is detailed in Section III.

C) EXTENDING SHELF LIFE - One of the most effective waste minimization programs that can be established is the active life-cycle management of hazardous materials before they become hazardous waste. All shelf-life material is either Type I or Type II.

- Type I shelf-life items are materials that have a set expiration date, which cannot be extended. Once this date has passed, the material cannot be used for its intended purposes and can be turned into DLA Disposition Services for resale. The containers must be unopened and in good shipping condition (no excessive rust).
- Type II shelf-life items are materials that do not have a specific expiration date. The manufacturer typically will recommend that the item be re-evaluated on a particular date. The label will usually state a "Test" or "Re-Inspect" date. Type II shelf-life items can be extended providing the material is still viable or usable. For most Type II materials, shelf-life extension tests are not complicated, do not require a laboratory, and can be done on the spot by anyone with a minimum of training (usually consisting of nothing more than visual checks for damage or deterioration). FISC Norfolk is available to assist with shelf-life extensions- please contact the HAZMINCENS for additional assistance.
- The General Services Administration (GSA) and all military services have developed separate storage standards. For example, shelf-life extension of paint can be accomplished according to the Federal Standard 793, "Depot Storage Standards". End users are authorized and encouraged to examine paint using FED-STD-793 guidelines or by using practical, end-use related tests to determine if the materials still meet their intended use. End users may extend the shelf life as long as the paint performs satisfactorily for their needs. Before disposing of paint, you are strongly encouraged to review FED-STD-793, paragraph 4. See NAVSUP P-485, Chapter 4, paragraph 4664 for further shelf-life material management guidance. For further assistance in determining if the shelf life can be extended, contact CHRIMP Technician on board or your supply officer. The best way to extend the life of all Type II materials is proper storage. For example, paints should not be stored below freezing and should be protected from rain or salt spray.
- DLA Aviation, formerly Defense Supply Center Richmond (DSCR), VA has a Quality Status List (QSL) which extends certain Type II Federal Stock Class (FSC) material. Included on the QSL are Federal Stock Classes (FSCs): 6635, 6750, 6810, 6840, 6850, 9110, 9150, and 9160. To obtain a copy of the microfiche that show the shelf-life extensions, contact DLA Aviation (see Appendix 1 for contact information).
- REFERENCES - "Shelf Life Identification Management and Control" (PIN# V805830) is a video available at any electronic media center. More information on DOD's shelf-life extension program may be found in Ref. D.

D) CROSSDECKING MATERIAL

HM may be available for no cost at the Reuse Store. Instead of bringing more HM (that must be managed in accordance with Navy guidelines) on Navy property, reuse another work center's overage. The Reuse Store is primarily located at NS Norfolk Building X-218. The Navy ERP (N-ERP) website provides Asset Visibility by Installation and Region and allows customers to see if material are available at their local HAZMINCEN for free issue or for purchase. N-ERP is a CAC enabled website so CAC certificate is required but a login and password may not be required to check material availability.

PLEASE NOTE!

Prior to receiving HM from another activity, contact your Safety representative or CHRIMP Technician to ensure that the material is authorized for use. The material must be listed on your Authorized Use List (AUL) or Type Ships Hazardous Material List (T-SHML). Also your Safety representative or CHRIMP Technician can assist you in obtaining a Material Safety Data Sheet (MSDS) for the item.

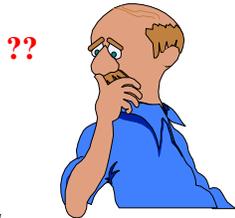
E) DLA DISPOSITION SERVICES, NORFOLK - may accept material for resale that the HAZMINCENs cannot accept, even expired materials. Contact DLA Disposition Services to ensure acceptance and to arrange for the transfer of material. Requirements include:

- 1) Containers should be in good condition-not rusted or dented
- 2) If kits are being turned in, all parts of the kit must be included
- 3) Paperwork required:
 - a. Two (2) copies of completed DD Form 1348-1A, or 1348-1 created in HICSWIN for each item. (See Appendix 2 for instructions).
 - b. MSDS for each item.
 - c. The Occupation Safety and Health Administration (OSHA) Hazardous Chemical Warning Label must be present on the items (must be adhesive type label).
- 4) Examples of materials ACCEPTED by DLA Disposition Services Norfolk:
 - All flammable materials (solvents, paints, etc.)
 - All photographic chemicals
 - Corrosive material (acids, bases, etc.)
 - Used synthetic oils and used synthetic hydraulic fluids
 - Mercuric nitrate
 - Cleaning compounds
 - Greases, POLs
- 5) Examples of materials NOT ACCEPTED by DLA Disposition Services Norfolk
 - Oxidizers (hydrogen peroxide, emergency escape breathing devices, etc.)
 - Dented or excessive rusted drums
 - Open containers
 - Compressed Gas Cylinders or Fire Extinguishers
 - Used items that would be considered waste
 - Items containing any level of polychlorinated biphenyls (PCBs)
 - Any radioactive materials

If your HM is rejected, please request a "917 rejection form" which provides specific information explaining why your HM was rejected. If the item was rejected for clerical reasons, make the necessary corrections and re-attempt transfer. Otherwise, contact the NAVFAC MIDLANT ESD for disposal of the item (see Section III for specific instructions).

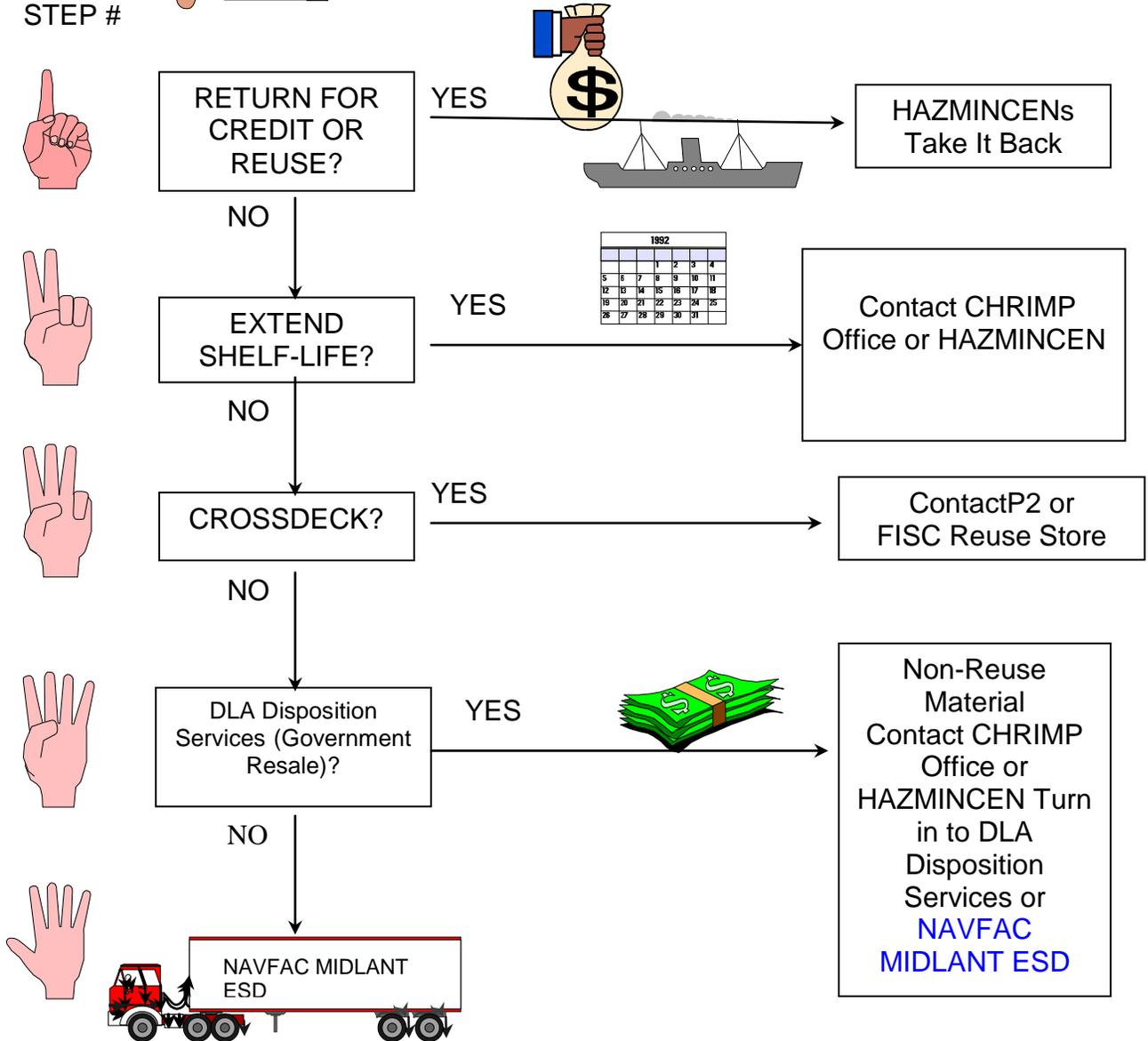
NOTE!

DO NOT TRANSPORT MATERIAL TO DLA WITHOUT PRIOR AUTHORIZATION FROM THE DLA HAZARDOUS MATERIAL PROCESSOR THAT MATERIAL WILL BE ACCEPTED



What to do with hazardous material?

STEP #



NOTE- SELF TRANSPORT OF HW IS NOT PERMITTED!

Under no circumstances should HW be transported by a vehicle not authorized by NAVFAC MIDLANT Environmental. It is illegal to transport HW without meeting the required EPA and DOT training, certifications and commercial driver's license endorsements.

III. HAZARDOUS WASTE MANAGEMENT AND DISPOSAL INFORMATION

What is a Hazardous Waste?

In accordance with Ref. E, for a material to become a hazardous waste it must first become a solid waste. A solid waste is any discarded material that is not excluded by regulation.

Discarded material can be a solid, liquid, or gas and is any which is:

- Abandoned
- Inherently Waste-Like (Hazardous Waste to be recycled)

A solid waste becomes a hazardous waste when it is:

- Not excluded or exempted by RCRA (examples of wastes that are not hazardous waste due to exclusions or exemptions are scrap metal and household waste).
- A Characteristic Waste (determined by generator knowledge or testing). These include wastes that are:
 - Ignitable
 - Corrosive
 - Reactive
 - Toxic
- A Listed Waste. These include wastes specifically identified in RCRA of the Code of Federal Regulations. (ex; 2,4-Dinitrotoluene, benzene, phenol, nitroglycerine, etc.)

If a HM is determined to no longer be suitable for its intended purpose and all other routes of utilization have been attempted, the last management alternative is disposal as waste.

NAVFAC MIDLANT ESD, the region's HW transportation and disposal agent and will pick up HW at Hazardous Waste Accumulation Areas (HWAAs), Satellite Accumulation Areas (SAAs), Universal Waste Accumulation Areas (UWAAs) and other specified locations.

Funding for disposal of Fleet (FLT) activity's generated wastes has been established. Non-FLT activities are required to submit a valid Job Order Number (JON) when turning in waste. For assistance in establishing a job order number, contact the appropriate Hazardous Waste Media Manager or NAVFAC MIDLANT ESD or follow the procedure in Appendix 8. HW management and disposal instructions are listed below.

A) USEFUL CONTACT INFORMATION - see Appendix 1.

B) ACCUMULATION OF HAZARDOUS WASTES – SHORE ACTIVITIES:

The EPA and the Virginia Department of Environmental Quality (VDEQ) regulate the management and disposal of HW. NAVFAC MIDLANT is the HW permit holder for the Navy. To ensure compliance, the appropriate Hazardous Waste Media Manager must approve establishment of all HW accumulation areas **prior to use**, as well as closure of the areas **prior to the planned closure date**. In addition, the Hazardous Waste Media Manager must be informed of any issues that have the potential to affect the Navy's ability to comply with the governing environmental regulations. All HW must be accumulated in designated areas. If HM is stored in the same location as HW, ensure the areas are clearly marked to identify HM from HW. There are three main types of authorized hazardous waste accumulation areas: Satellite Accumulation Areas (**SAAs**); Hazardous Waste Accumulation Areas (**HWAAs**); and Universal Waste Accumulation Areas (**UWAAs**).

1. SATELLITE ACCUMULATION AREA (SAA)

SAA PURPOSE: to allow proper management of HW as it accumulates without interfering with the work process. There are no limits on the number of waste streams that can be accumulated, but the TOTAL AMOUNT MUST NOT EXCEED 55 gallons (or 1 quart of acutely hazardous waste). Each waste stream shall be stored in a separate container and the container must be compatible with the waste being stored. If a SAA will be unattended due to unit deployment, project ending, etc., waste must be turned in to NAVFAC MIDLANT ESD and the Hazardous Waste Manager contacted to have the area shutdown two weeks in advance.

GENERAL REQUIREMENTS FOR ALL HW AREAS

- All containers must be labeled and kept closed except when adding or removing waste.
- Operators must be trained annually on proper area management and emergency response procedures.
- Areas must be identified with legible signs as a SAA with the point of contact's information, NO SMOKING, and emergency procedures and numbers.
- Areas must have adequate suitable spill control equipment to contain contents of the area should a spill occur. Spill equipment/supplies must be maintained. Follow spill reporting procedures in Appendix 3
- A fire extinguisher must be located within 50 feet of the area. An ABC type extinguisher is recommended. The fire extinguisher shall be routinely inspected in accordance with safety or fire departments requirements.
- Good housekeeping standards must be employed at all times. Keep areas orderly with adequate aisle space and clear of trash.

SAA SPECIFIC REQUIREMENTS: a SAA area must meet several criteria, including:

- Be located at or near the point of waste generation.
- Be under the control of the operator of the process that generates the waste.
- Operators must be trained annually on proper area management and emergency response procedures.
- Containers must be labeled with the words "Hazardous Waste" and the contents of the container.
- The container does not require an accumulation start date, however, if a container becomes full prior to pick up, it must be dated immediately, and moved to an approved HWAA or a permitted facility within 72 hours.
- May only store a max of 55-gal total of all HW (or 1 quart acutely hazardous waste).

SAA INSPECTIONS:

The checklist included in Appendix 5 provides a concise listing of the regulatory requirements of a SAA. It is **highly recommended** that each HW generator perform undocumented reviews of their SAA at least weekly, using the checklist. The Installation Environmental Office will perform SAA inspections at least quarterly to provide technical support, management guidance, and regulatory oversight.

SAA DISPOSAL PROCESS:

When a container is 75% full (or one quart of acute HW), contact NAVFAC MIDLANT ESD to schedule a pickup. Be sure to inform Dispatcher your area is a SAA site.

2. HAZARDOUS WASTE ACCUMULATION AREA (HWAA)

HWAA PURPOSE: to allow for the temporary accumulation of HW in preparation for transportation to a permitted treatment, storage or disposal facility.

GENERAL REQUIREMENTS FOR ALL HW AREAS

- All containers must be labeled and kept closed except when adding or removing waste.
- Operators must be trained annually on proper area management and emergency response procedures.
- Areas must be identified with legible signs as a HWAA with the point of contact's information, NO SMOKING, and emergency procedures and numbers.
- Areas must have adequate suitable spill control equipment to contain contents of the area should a spill occur. Spill equipment/supplies must be maintained. Follow spill reporting procedures in Appendix 3
- A fire extinguisher must be located within 50 feet of the area. An ABC type extinguisher is recommended. The fire extinguisher shall be routinely inspected in accordance with safety or fire departments requirements.
- Good housekeeping standards must be employed at all times. Keep areas orderly with adequate aisle space and clear of trash.

HWAA SPECIFIC REQUIREMENTS:

- Provide at least 14-days notice to the Hazardous Waste Media Manager prior to the need for a HWAA set-up to allow for area set up and timely notification to the VDEQ.
- Provide at least seven (7) days notice to the Hazardous Waste Media Manager prior to closure of a HWAA.
- Containers must be labeled with the words "HAZARDOUS WASTE", contents of the container, and the start date of when the waste is placed in the container.
- Must be inspected every seven (7) calendar days.

HWAA INSPECTIONS:

Operators of a HWAA must perform a documented inspection of their site every seven (7) calendar days and maintain those inspection records for three (3) years. The inspection is to be documented using the HWAA checklist that is included in Appendix 6. The checklist provides a concise listing of the regulatory requirements of a HWAA.

Any deficiency/violation must be corrected immediately. Deficiency corrections must be noted on the inspection sheet in the space provided. Corrective action taken, date accomplished, and initials of person performing corrective actions must be recorded.

The Installation Environmental Office will perform HWAA inspections at least quarterly to provide technical support, management guidance, and regulatory oversight.

HWAA DISPOSAL PROCESS:

At or before 45 days of accumulation, contact the NAVFAC MIDLANT ESD to schedule a pickup of the waste. If waste is not picked up by the ESD within their allotted service response time (1 week), recall the ESD immediately!

3. UNIVERSAL WASTE ACCUMULATION AREA (UWAA)

UWAA PURPOSE: to allow for the temporary accumulation of specific waste streams in preparation for transportation to a permitted treatment, storage or disposal facility.

GENERAL REQUIREMENTS FOR ALL HW AREAS

- All containers must be labeled and kept closed except when adding or removing waste.
- Operators must be trained annually on proper area management and emergency response procedures.
- Areas must be identified with legible signs as a UWAA with the point of contact's information, NO SMOKING, and emergency procedures and numbers.
- Areas must have adequate suitable spill control equipment to contain contents of the area should a spill occur. Spill equipment/supplies must be maintained. Follow spill reporting procedures in Appendix 3
- A fire extinguisher must be located within 50 feet of the area. An ABC type extinguisher is recommended. The fire extinguisher shall be routinely inspected in accordance with safety or fire departments requirements.
- Good housekeeping standards must be employed at all times. Keep areas orderly with adequate aisle space and clear of trash.

UWAA SPECIFIC REQUIREMENTS:

The current Universal Waste regulations apply to four types of widely generated HW: *batteries, pesticides, mercury-containing equipment, and lamps*. All UWAA's must adhere to various environmental regulatory requirements including:

- Containers must be labeled with the words "UNIVERSAL WASTE", contents of the container, and the start date of when the waste is placed in the container.
- A seven (7) day advance notice should be provided to the Hazardous Waste Media Manager to allow time for set up of the UWAA. For closure of a UWAA, contact the Hazardous Waste Media Manager before the planned closure date.

UWAA INSPECTIONS:

It is **highly recommended** that each generator perform monthly reviews of their UWAA using the checklist in Appendix (7).

The Installation Environmental Office will perform UWAA inspection at least quarterly to provide technical support, management guidance, and regulatory oversight. The standard operating procedure and inspection checklist for UWAA's are included in Appendix 7.

UWAA DISPOSAL PROCESS:

At or before 270 days of accumulation (9 months), prior to expiration of the one year accumulation period, contact NAVFAC MIDLANT ESD to schedule a pickup of the waste. Inform the NAVFAC MIDLANT ESD that your waste is stored in a UWAA.

C) WASTE PACKAGING REQUIREMENTS - SHIPS OR SHORE ACTIVITIES

Hazardous waste must be properly packaged in the original or an approved container. DOT requires specific packaging for shipment. Direct specific questions regarding container availability and packing requirements to the NAVFAC MIDLANT ESD.

NOTE! ONLY NAVFAC MIDLANT ESD OR A PRE-APPROVED CONTRACTOR IS PERMITTED TO TRANSPORT HW WASTE OFF BASE OR ON OPEN ROADS UNDER ANY CIRCUMSTANCES. IT IS ILLEGAL TO TRANSPORT HW ON PUBLIC ROADWAYS WITHOUT MEETING THE REQUIRED EPA AND DOT TRAINING, CERTIFICATIONS, COMMERCIAL DRIVERS LICENSE ENDORSEMENTS, AND PROPER SHIPPING DOCUMENTS.

a. MATERIAL / WASTE PAPERWORK REQUIREMENTS – SHIP OR SHORE

- Four completed copies of the DD Form 1348-1A, or 1348-1 created in HICSWIN, are required for turn-in of unusable HM or HW to NAVFAC MIDLANT ESD. Instructions on how to complete this form are listed in Appendix 2.
- Contact the NAVFAC MIDLANT ESD at 757-341-0412/0460 and fax a copy of the completed DD Form 1348-1A, or 1348-1 created in HICSWIN, to 341-0436 prior to scheduling a pickup and to ensure prompt service.
- All four copies of the DD Form 1348-1A, or 1348-1 created in HICSWIN, are required at time of pickup. Copies are distributed as follows: client, MIDLANT driver, on container, and returned to FISC.
- For ships, one copy of the 1348-1 created in HICSWIN with the ECAP acronym stamped on the document and signed by the CHRIMP Technician is needed.
- For material that was not procured through the Navy stock system, a Material Safety Data Sheet (MSDS) is required.

b. MATERIAL / WASTE TURN-IN REQUIREMENTS – SHIPS

- Ships in local private shipyards: Contact the CHRIMP Office to initiate this action for you. Only CHRIMP Technicians are authorized to contact NAVFAC MIDLANT ESD to schedule a pickup of the waste. Allow adequate time for waste screening and quality control (QC) for CHRIMP and NAVFAC MIDLANT ESD.
- Ships at Norfolk Naval Shipyard: contact the NNSY Occupation, Safety, Health, and Environmental Office (Code 106), for assistance with HW disposal.
- Ships at Naval Weapons Station Yorktown: contact the NAVFAC MIDLANT ESD to arrange an offload.
- Ships at NS Norfolk (4 pallets or less) or JEB Little Creek (2 pallets or less): NAVFAC MIDLANT ESD offers several HW pickup points on the piers. The specific piers and pickup times are listed below. Each ship is to contact and coordinate with their assigned CHRIMP Technician. A representative from the ship must accompany the HW from the time it leaves the ship to the time it is picked-up by NAVFAC MIDLANT ESD. **Under no circumstances shall waste be left unattended or abandoned on piers**

Naval Station Norfolk Pier pickup schedule is: Monday – Friday

0800-0915	Pier 9
0800-0915	Pier 12
1000-1115	Pier 3
1000-1115	Pier 4

4 pallets or less

JEB Little Creek Pier pickup schedule is: Tuesday and Thursday

0800-0900	Pier 15
1000-1100	Quaywall

2 pallets or less

- Ships at NS Norfolk (more than 4 pallets) or JEB Little Creek (more than 2 pallets) must request and turn-in through the CHRIMP Office, the Logistic Support Representative (LSR) or the FISC Hazmat representative. Once informed of a request for off-load, the CHRIMP Technician will screen the material and determine what is still usable and what is waste. The CHRIMP Technician and NAVFAC MIDLANT ESD representatives will then coordinate the off-load. A representative from the ship must accompany the waste until it is picked up by the NAVFAC MIDLANT ESD. Under no circumstances shall waste be left unattended or abandoned on the piers. If possible, ships should utilize the pier pickup option over the course of several days instead of scheduling an offload.

PLEASE NOTE!

It is a violation of state and federal law to abandon HM/HW.

IV. MANAGEMENT OF SPECIFIC MATERIALS/WASTES

A) USEFUL CONTACT AND WASTE PICKUP INFORMATION – see Appendix 1

B) WASTE MANAGEMENT REQUIREMENTS

All waste turn-ins to NAVFAC MIDLANT ESD require four copies of the DD Form 1348-1A (for shore activities) or 1348-1 (for ships). For instruction on completing Form 1348, see Appendix 2.

A job order number (JON) may be required for certain environmental services. To establish a JON, follow the procedure in Appendix 8.

For items not listed below, please contact your installation Hazardous Waste Media Manager!

PLEASE NOTE!

**BAGGED WASTE WILL ONLY BE ACCEPTED FOR PICK-UP IN CLEAR BAGS!
RED OR YELLOW BAGS SHALL NEVER BE USED!**

1) ABSORBENT MATERIAL (a.k.a. SPEEDY-DRY, KITTY LITTER)

- If the absorbent material was used to absorb HW or HM, it must be managed as a HW.
- If the absorbent material has been used to absorb oil, the absorbent will be managed in a similar fashion as oil. Oily absorbent materials should be fully utilized prior to disposal and must be placed in clear plastic bags and then containerized and turned in to the NAVFAC MIDLANT ESD.
- Please refer to section I for absorbent green alternatives. Using greener absorbents may increase product efficiency and reduce waste generation.
- See IV.B.28 for oily rag management.

2) AEROSOL CANS

Return unused aerosol cans to the HAZMINCEN for potential reuse. Contact your HAZMINCEN for more details. Also see the Material Reutilization Information (Section II) of this guide for additional alternatives to disposal. If the cans are rejected by the HAZMINCEN and the additional options listed in Section II of this guide are non-applicable, manage the aerosol cans as applicable below:

- a. **Aerosol cans containing Petroleum Base Products (Oils and Lubes), corrosives, Freon, pesticides, insecticides, fungicides, CFCs or oven cleaners:** These cans shall not be punctured and must be turned in to the NAVFAC MIDLANT ESD.
- b. **Punctured Aerosol Cans:** Shore Tenants have the option to puncture aerosol cans using equipment approved by the Hazardous Waste Media Manager. The site POC is responsible for restricting access to the aerosol puncturer to ensure correct use. The contents of the punctured

cans must be collected and must be managed as HW: contact the Hazardous Waste Media Manager to establish the appropriate accumulation area. Punctured aerosol cans may then be placed in Metals Dumpsters for recycling. ****NOTE-Aerosol cans containing pesticides and oven cleaners shall not be punctured****

THERE ARE NO NAVSEA APPROVED AEROSOL PUNCTURE DEVICES FOR SHIPBOARD USE. SHIPS ARE NOT AUTHORIZED TO PUNCTURE AEROSOL CANS!

- c. **Un-punctured Aerosol Cans:** Contact the Hazardous Waste Media Manager to set up an appropriate accumulation area to manage aerosol cans. Aerosol cans must either have tops in place or nozzles removed prior to containerizing.
- 3) **ANTIFREEZE** – is typically managed as a non-RCRA regulated waste. Contact the Hazardous Waste Media Manager to determine proper disposition. Do not mix the antifreeze with solvents or metals, as the mixture could result in a hazardous waste.
- 4) **APPLIANCES/WHITE GOODS (A/C&R Equipment)– see Recycling Section**
- 5) **AQUEOUS FILM FORMING FOAM (AFFF)**– will be managed by NAVFAC MIDLANT ESD. Contact NAVFAC MIDLANT ESD to schedule a pickup. AFFF in original containers can be turned in to the Reuse Store (NS Norfolk Building X-218).
- 6) **ASBESTOS**
- For asbestos removal from shore command pipes, buildings, roofs, floors, ceilings, etc., contact NAVFAC MIDLANT ESD to schedule an asbestos removal or waste pick-up. Four completed copies of DD Form 1348-1A and a valid Job Order Number (JON) are required.
 - For asbestos removal operations aboard ships or submarines contact the Ship Support Office.
 - If you are unsure if you are dealing with asbestos, shore activities should contact the NAVFAC MIDLANT ESD and ships should contact the Navy Environmental Preventative Medical Unit #2 (NEMPU-2).
 - For disposal of safes and file cabinets that possibly contain asbestos, shore commands should contact CNRMA Safety to confirm asbestos presence. Disposal must be coordinated with your Hazardous Waste Media Manager. The safe must be double wrapped in plastic by the generator and delivered to DLA Disposition Services at St. Juliens Creek. Contact DLA to schedule an appointment and to ensure you have the proper paperwork. If transportation is required, call MIDLANT Transportation Services for assistance.
 - For demolition and renovation operations, see section IV.8, entitled “BUILDING MATERIALS.”

7) **BATTERIES** - All batteries are not managed in the same manner. Below are the specific disposal guidelines.

- Alkaline Batteries: Alkaline batteries such as AAs, C, and D batteries can be disposed of as normal trash.
- Lead acid batteries: Lead acid batteries shall be turned into Recycling.
- Rechargeable batteries: The Call2Recycle program is designed to recycle your old, rechargeable batteries from items such as cell phones, lab tops, power tools, etc. at no costs to your facility. Rechargeable batteries that are accepted through Call2Recycle include Nickel Metal Hydride, Nickel Cadmium, Lithium Ion and Nickel Zinc. (See Appendix 9)
- All other batteries: Such as lithium, NICAD, mercury, lithium sulfur dioxide, and magnesium dioxide, shall be managed as Universal Waste in accordance with Section III.B.3. The batteries will be packaged to prevent shorting, (i.e. one battery to one Ziploc bag or terminals taped over). Contact NAVFAC MIDLANT ESD to schedule a pickup.

8) **BUILDING MATERIALS** - Building materials from demolition or renovation operations which are suspected to contain lead and/or asbestos should be characterized with representative sample(s) of the entire waste stream tested prior to disposal. Contact the Hazardous Waste Media Managers for specific guidance. For safety-related issues, contact the Regional Safety Department or your command's Health and Safety official.

REMEMBER: IMPROPER MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTE VIOLATES STATE AND FEDERAL LAWS.

9) **CALCIUM HYPOCHLORITE and SODIUM HYPOCHLORITE** are highly unstable (i.e., strong oxidizers), and corrosive chemicals. There have been several instances when improper storage and handling of these chemicals has resulted in fires. In addition exposure can cause extreme damage to the skin and eyes.

Handle Hypochlorites carefully. Do not allow these containers or any packaging material to become wet. Store in compatible containers off the ground so that the containers do not come in contact with a wet floor. Inspect containers for physical integrity, notify ESD if you have any containers that are physically damaged so that they may be repackaged and disposed of promptly. Do not allow these chemicals to come in contact with combustibles such as swept material from the floor, oily rags, etc. Follow the directions specified in Material Safety Data Sheet for appropriate handling and in the event of a spill. Consult Safety and your HW Media Manager for additional information.

10) **CONTRACTOR PROJECTS** – For all waste generated onboard a Naval installation, it is the liability and responsibility of the Navy to ensure proper management and disposal. Specific arrangements for transportation and disposal of the waste vary by

contract. Please contact your HW Media Manager for questions related to waste generated during contracted projects.

11) COOKING OIL

Used cooking oil/grease can be recycled. Do not mix hazardous materials (i.e. solvents/paints) with cooking oil or grease. Do not dispose of cooking oil or grease in trash dumpsters or any drains.

At NS Norfolk there are three 300-gallon containers available for the collection of used cooking oil/grease. The containers are located at the heads of Piers 3, 10, and 14. The collection containers are located near the trash and metal only dumpsters.

*Do not store pallets of cooking oil against buildings, instead store them near the dumpster(s). If questions exist regarding the use of these containers, contact the Hazardous Waste Media Manager.

At JEB Little Creek, grease should be managed in pier-side containers or in appropriate containers at food locations.

12) CYLINDERS – (Compressed Gas Cylinders – CGC)

- Empty CGCs can be turned into recycling, see section I.D. for requirements.
- For CGCs that are not empty, including those containing Ozone Depleting Substances (ODS) such as refrigerants and halons:, you must contact the NAVFAC MIDLANT ESD for disposal. Complete and submit a 1348-1A form to the ESD. Ensure the 1348-1A form contains a valid Job Order Number, and:
 - compressed gas type
 - physical condition of cylinder(s)
 - length of cylinder(s) measured from the cylinder bottom to the valve opening; do not include the valve stem length
 - circumference or diameter of cylinder(s)
 - amount of compressed gas in cylinder(s)
 - owner of the CGC (the CGC will be returned to the owner if applicable)

13) DESICCANTS – Some desiccants may be disposed of as solid waste; contact your HW Media Manager for disposal requirements.

14) ELECTRONIC WASTES (E-WASTES) - contact DLA for guidance.

15) EXPLOSIVE WASTES – for all ammunition explosive waste or waste classified by the DOT regulations as explosive, contact your HW Media Manager for guidance.

16) FLUORESCENT / OTHER LIGHT BULBS

- **Fluorescent light bulbs (green-tip* and silver-tip), compact fluorescent bulbs, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide bulbs are to be managed as Universal Waste. Please contact your HW Media Manager for guidance. * Low mercury bulbs, often referred to as “Green tip” bulbs still contain low levels of mercury and shall be managed as Universal Waste.**

- Except at JEB Fort Story, all tube fluorescent light bulbs will be turned into the Self-Help Facility (one for one exchange) or managed as a universal waste in accordance with Section III.B.3. All other bulbs shall be managed as a universal waste and then turned in via 1348 to the NAVFAC MIDLANT ESD.
- At JEB Fort Story, tube fluorescent bulbs shall be turned in via 1348 to Building 1011 on Tuesdays from 10:30am-11:30am. A light bulb turn-in form will be provided to obtain new light bulbs. All other bulbs shall be managed as a universal waste and then turned in via 1348 to the NAVFAC MIDLANT ESD.
- Afloat commands- turn in via pier-side pickup (see Section III.C).
- PCB-containing fluorescent light ballasts are to be turned into NAVFAC MIDLANT ESD as PCB waste. To schedule a pickup call NAVFAC MIDLANT ESD. Any non-PCB fluorescent light ballasts can be turned in to RRP.

PLEASE NOTE!

Fluorescent light ballast that do not possess the marking “PCB free” are to be assumed to contain PCBs and should be managed accordingly.

- Standard household incandescent bulbs may be disposed of in regular trash.

17) FUEL FILTERS (OIL, JP-5, DIESEL AND GASOLINE)

- **Gasoline/JP-8 Filters, due to ignitability, shall be managed as hazardous waste.** Contact your HW Media Manager prior to generating gasoline filters for guidance.
- **JP-5, Diesel, and other Oil Filters**
 - Drain for a minimum of 72 hours to remove liquids (when cold draining filters, puncturing the top can aid in removing oil from filter)
 - Double bag drained filters in clear plastic bags (no more than 10 in one bag), and place in the trash or turn over to NAVFAC MIDLANT ESD or NAVFAC MIDLANT Oil Recovery for disposal.

18) INDUSTRIAL WASTEWATER - depending on the wastewater characteristics and facility permit requirements, some wastewaters may be treated at the Navy's Industrial & Oily Wastewater Treatment Plants (IWTPs) or will have to be disposed of off base via DLA. Do not mix industrial wastewater with any other wastes. For more information and assistance in disposing of industrial wastewasters contact your Water Media Manager.

19) LEATHER ITEMS- Leather materials generated from activities occurring in maintenance and welding shops, laboratories, and aboard ships shall be managed as hazardous waste and turned into NAVFAC Environmental Services for proper disposal. This includes but is not limited to leather gloves, boots, and various PPE. Should an installation tenant or command require an accumulation area for the

storage of such leather material, please contact your installation's hazardous waste media manager.

Leather materials generated from office spaces, including but not limited to chairs and sofas, will be turned into DLA for proper management. Should DLA not accept this material, please contact your installation's hazardous waste media manager for proper guidance.

20) LOW LEVEL RADIOACTIVE MATERIAL - (ex: smoke detectors, Tritium EXIT signs, Radium gauges & dials, some watches and compasses) is disposed of through the Radiological Support Office (RASO). To dispose of these items, contact RASO with the following information:

- Manufacturer Name, Trade Name, and Model Number
- National Stock Number (if applicable)
- Radiological Hazard (if known) and Amount (if known)
- Quantity of each
- Location of Items

21) MEDICAL / BIO-HAZARDOUS WASTE OUTSIDE OF MEDICAL FACILITIES

Medical/Bio-Hazardous waste includes human blood and all body fluids.

- In the event of an emergency and/or incident that generates a medical/bio-hazardous waste, tenants should contact their Facilities Management Specialist who will arrange for the proper management and disposal of this waste stream.
- Please contact your Hazardous Waste Media Manager if you have any questions regarding medical/bio-hazardous waste.

22) METHYL ETHYL KETONE PEROXIDE (MEKP)

Due to the reactive nature of this material and its high disposal costs; MEKP will be issued in either 1-ounce resin kits (NSN 6810-01-452-3268) or 2-ounce resin kits (NSN 6810-01-452-3273). Every attempt should be made to completely consume the accelerant (MEPK) in the process. To dispose of unusable quantities of MEKP, contact the NAVFAC MIDLANT ESD at for guidance.

23) OBA (Oxygenated Breathing Apparatus) CANISTERS / EEBD (Emergency Escape Breathing Device)/Nuclear/Biological/Chemical (NBC) Filters

Contact the NAVFAC MIDLANT ESD to arrange a pickup. The OBA canisters, EEBDs, and NBC filters need to be kept in the original packages. Do not attempt to disassemble the original packages.

24) OIL, USED

- **Used petroleum based oils** can be recycled. Label the container with the words **USED OIL**. Contact NAVFAC MIDLANT ESD for further instructions or to schedule a pickup.

- At the point of generation it is acceptable to consolidate the following **petroleum-based** products Used Oil, Used Hydraulic Fluid, Used PD-680 Type II, or Used JP-5 in the same container.
- **Mixtures of Used Oil and Used Gasoline or MoGas are prohibited and must be managed as HW.**
- **Used synthetic based oils** cannot be recycled and must be turned in to NAVFAC MIDLANT ESD. Do not mix synthetic oils/fluids with petroleum products.
- **Ship Generated Oily Waste:**
 - **Acceptable Oily Wastes-** Non-contaminated bilge, ballast, and ship's fuel tank cleaning wastes, including butterworthing rinse water, may be disposed of as oily waste.
 - **For all other oil containing wastes, contact** the Water Media Manager who will determine proper disposal procedures.
 - **Ensure no contaminants** have entered the bilge water or oily waste.
 - **Unacceptable contaminants include**, but are not limited to: Aqueous Film Forming Foam (AFFF); sewage (black water and gray water); HM and HW; JP4, AVGAS, MOGAS, and gasoline; boiler cleaning wastes; anti-freeze; and FSII (Fuel System Icing Inhibitor).
 - **Oily Waste Transfers During Night Hours** (between sunset and sunrise) are not normally permitted due to reduced ability to immediately detect a spill; inability to determine amount and spread of a spill; and the need to recall and fund oil clean-up personnel. Approval for ships to discharge oily waste after dark must be obtained from the CO of the appropriate installation by phone call to the local Port Ops Officer. The following additional requirements must be in place:
 1. Extra Topside Safety Watches stationed at the discharge station and on the pier or SWOB to monitor the water for any oil sheens;
 2. Oil spill clean-up equipment on hand;
 3. Adequate lighting erected; and
 4. The Chief Engineer will be on board to supervise the evolution.
 - **AT NAVSTA Norfolk**
 1. Piers are equipped with oily waste collection piping and risers for off-loading bilge water and non-contaminated oily wastes. NAVFAC MIDLANT's Ship Support Office (SSO) will coordinate connections and disconnections to the collection system through LOGREQS. To ensure adequate resources are available to respond in the event of a system casualty, discharges to the system are only permitted during daylight hours during the regular workweek.
 2. Vessels must have a 2.5 in. male camlock fitting on their oily waste overboard discharge connection in order to connect. Vessel connections will be scheduled by SSO to occur approximately 24 hours after arrival. Following connection to the system, the vessel must check for leakage from the hose and connections by flushing the hose with seawater for 5 minutes. A "T" adapter is available from NAVFAC MIDLANT, which will allow use of a 1.5 in. fire hose to flush the hose. Disconnection from the system will occur approximately 48

hours before vessel departure. Prior to disconnection, the vessel must flush the hose with seawater for 10 minutes to remove residual oil. The vessel is responsible for lowering the hose to the pier and walking the residual seawater in the hose into the pier riser. If the vessel was issued a "T" adapter, the adapter must be returned to NAVFAC MIDLANT.

3. Individual off-loads of greater than 50K Gallons, or discharge rates greater than 200 gpm, must be coordinated through SSO to ensure the pier collection system capacity is not exceeded. It is the responsibility of vessels to periodically observe the connections and hose and to report any unusual conditions that may occur.
 4. If the pier side collection system is nonoperational, NAVFAC MIDLANT SSO will arrange for collection services via a contractor or NAVFAC MIDLANT Oil Recovery Tanker Truck, square/Frac tank, or SWOB. If the vessel uses their shipboard oil water separator, NAVFAC MIDLANT SSO will coordinate pick-up of oil from the shipboard used oil tanks.
 5. Do not discharge viscous oils in to the discharge lines, this has been shown to cause failures (fuel spills).
- **At JEB Little Creek-Ft. Story:** The Ship Support Office (SSO) provides oily waste collection and handling services. For emergency requirements outside normal working hours, contact JEB Little Creek Port Ops.
 - **At WPNSTA Yorktown/Cheatham Annex:** If possible, oily waste should be off-loaded before arrival. If off-load at the facility is required, approval by the Installation Commanding Officer prior to off-loading must be obtained and NAVFAC MIDLANT Oil Recovery should be contacted for disposal.

25) PAINTS

- **Empty paint can:** is defined as an original paint can that is free of liquids and contains less than 1 inch (or 3% by volume) of dried material.
 - Metal paint cans that meet this standard can be placed in dumpsters marked "metal only"; plastic cans be placed in solid waste dumpsters.
 - Paint cans that DO NOT meet this standard must be managed as HW and turned in to NAVFAC MIDLANT ESD for disposal and must not be allowed to air dry.
- **Unused/unopened containers of paint:** should be returned to the HAZMINCEN for potential reuse. Keep containers closed; do not allow to air dry. Please see the Hazardous Material Reutilization Information section of this guide for more information and additional alternatives to disposal. If the cans are rejected by the HAZMINCEN, the items will be managed as a waste; follow the procedure listed below:
 - Liquid or solidified oil-based paint: is to be managed as a HW and properly labeled. Contact NAVFAC MIDLANT ESD to schedule a pickup. Excess un-used paint should be accumulated separately from solvent waste.

- Oil-Based Paint/Solvent related items: such as brushes, rags, and rollers shall be managed as HW. *Immediately containerize and keep containers closed at all times. Air drying is prohibited.
- Water-based (latex) paint: is to be managed as non-regulated. Properly label the container and Contact NAVFAC MIDLANT ESD to schedule a pickup. Keep cans closed. Air drying is prohibited.
- Water Based (latex) Paint Debris: such as brushes, rags, and rollers will be managed as non-regulated and can be disposed of as solid waste.

26) PARTWASHERS

- Parts washer units utilize various substances such as solvents to remove dirt, lubricants, and other foreign particles from equipment components. When this solvent becomes contaminated to the point where it must be replaced, contact your HW media manager to ensure proper waste characterization.
- If your operations change, contact your HW media manager to ensure proper waste characterization.
- Do not assume that an environmentally friendly cleaning agent will not produce HW. Waste characterization depends on factors including what is being cleaned. Contact your HW media manager to ensure proper waste characterization.
- HW solvent must be turned in to the NAVFAC MIDLANT ESD for disposal.
- For units maintained by a private company (i.e. Safety Kleen), contact your HW media manager to ensure proper waste characterization and disposal. Prior to off-site shipment of this waste, information about the waste must be provided to the NAVFAC MIDLANT ESD and a representative from the ESD must be present to sign the Hazardous Waste manifest.

27) PEST MANAGEMENT CONTROL-Contact the NAVFAC MIDLANT ESD for Pest control services.

28) POLYCHLORINATED BIPHENYL (PCB)

PCBs were domestically manufactured from 1929 until their manufacture was banned in 1979. They have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications. The most common trade name is Aroclor. Although no longer commercially produced in the United States, PCBs may be present in products and materials produced before the 1979 PCB ban. Products that may contain PCBs include:

- Transformers and capacitors
- Other electrical equipment including voltage regulators, switches, reclosers, bushings, and electromagnets
- Oil used in motors and hydraulic systems
- Old electrical devices or appliances containing PCB capacitors
- Fluorescent light ballasts (not green tips)

- Cable insulation
- Thermal insulation material including fiberglass, felt, foam, and cork
- Adhesives and tapes
- Oil-based paint
- Caulking, plastics, carbonless copy paper, floor finish

If you have items for disposal that you believe may contain PCBs, please contact the NAVFAD MIDLANT ESD for guidance on disposal.

PCB-containing fluorescent light ballasts are to be turned into NAVFAC MIDLANT ESD as PCB waste. To schedule a pickup call NAVFAC MIDLANT ESD. Any non-PCB fluorescent light ballasts can be turned in to RRP.

PLEASE NOTE!

Fluorescent light ballast that do not possess the marking “PCB free” are to be assumed to contain PCBs and should be managed accordingly.

29) RAGS / SHOP TOWELS/CLOTH ABSORBENTS

- **Oily Rags:** Place the rags in clear double plastic bags and label as “Used oil rags”.
 - **At Naval Station Norfolk:* Oily rags can be taken to the NAVFAC MIDLANT Oil Recovery located at Bldg. Q-50.
 - **At Naval Weapons Station Yorktown:* Oily rags can be taken to Building 2035 on Tuesdays and Thursdays from 7:30 to 9:00 AM.
 - **At JEB Little Creek and NAS Oceana* or if you do not have the ability to transport your rags, contact NAVFAC MIDLANT ESD at to schedule a pickup. Regardless if the rags are dropped off or picked-up, four completed copies of DD Form 1348-1A, or 1348-1 created in HICSWIN, for each item are required for turn-in.
- **Hazardous Waste (HW) Rags:** Rags that have been contaminated with HM/HW, such as MEK, gasoline, solvent or paint thinner must be managed as HW and properly labeled. Contact NAVFAC MIDLANT ESD to schedule a pickup. Do not transport rags that are considered hazardous waste. *Immediately containerize and keep containers closed at all times. Air drying is prohibited.
- **Shop Towel Laundering Service:** The current Navy Shop Towel Afloat/Ashore Management Program (STAMP) contract for the Mid-Atlantic/Northeast Region; N00189-07-D-Z010 is available on the DENIX Website at <https://www.denix.osd.mil> or from the Rag Recycling Contract Administrator. Note: All Naval vessels in port and shore activities are covered by this STAMP contract.

The current shop towel contract requires the customer to either use shop towels provided by the contractor or to own their own towels and have the contractor wash them. In the first scenario, the local contractor delivers an agreed upon quantity of towels to ship. On a schedule that has been agreed-upon, the contractor picks up soiled shop towels and replaces them with clean towels. The ship is then billed for the towels washed as well as the towels that are lost/missing. In the second scenario, the ship/government buys shop towels

and has the contractor pick them up on an agreed-upon schedule and bills the ship for the cost of washing. To obtain further assistance, contact your CHRIMP Technician or the Rag Recycling Contract Administrator.

The P2 Program may be able to provide 55-gallon-drum mounted wringers and small table top wringers that remove free liquids in rags, allowing for additional uses. P2 equipment is also available at DLA free of charge. For more information, contact the P2 Media Managers.

30) RAILROAD TIES

Railroad Ties must be sent to a permitted landfill for proper disposal. Disposal must be coordinated with the Regional Solid Waste & Recycling Program who will arrange for a dumpster. Railroad ties shall not be placed in regular Solid waste dumpsters.

31) SILVER / SILVER RECOVERY UNITS

Solutions used in silver recovery units (i.e. photography shops, weapons x-ray, dental or hospital/ship X-ray rooms) may require management as a HW. Contact the HW Media Manager for guidance on the management of these units.

32) SOIL GUIDANCE

Soil cannot be removed from construction sites without NAVFAC MIDLANT Environmental Office authorization. This also includes any soil/debris removed from stormwater drainage structures. Any movement of soil/fill material outside of project boundaries, meaning both soil brought onsite and soil from the site relocated to other areas, must be coordinated with the installation Hazardous Waste and the Pest program managers to ensure proper characterization, which may require testing, and environmental compliance. If the excavated soil is going to be reused in the construction site (i.e. for grading), no characterization is required.

Soil should be stored in a manner that prevents rain from infiltrating the soil matrix and preventing any runoff into the surrounding soil or pavement (e.g. store the soil on top of plastic sheets and covered with plastic sheets or in lined, covered dumpsters).

33) SOLVENTS (i.e. PD-680/Acetone/Alcohols etc.)

All Solvents shall be turned in to the NAVFAC MIDLANT ESD for disposal as HW. Ensure containers are kept closed at all times.

34) SPENT BLAST MEDIA

Spent blast media from blast booths or gloves boxes have the potential for recycling instead of disposal. Ensure blast media is reused/recycled within the blast booth/glove box until it is no longer feasible prior to disposal. Properly label waste container and contact NAVFAC MIDLANT ESD to schedule a pickup.

- Initiate conversation with your blast media supplier to investigate the potential of a take back or recycling program. Contact the installation HW Media Manager for guidance and assistance.

35) TETRAHYDROFURAN (THF)

THF is a chemical that is commonly used as a softener, cleaner, and a bonding enhancer for fiberglass, plastic and rubber, and may be found in such things as boat repair kits. THF degrades by auto-oxidation into crystalline form over time or if exposed to air for a time and presents an explosives risk. THF in crystal form is **highly unstable** and must be disposed of as an emergency response using detonation by EOD or a qualified contractor.

For any THF material, whether still in liquid form or crystallized, notify your base Safety and the Hazardous Waste Media Manager for proper disposal. **Do not** attempt to open, move, or transport the material until it can be properly assessed for continued use/storage/disposal. Targeted NIINS may include item 01-271-4835 and item 01-339-3640.

36) UNKNOWN -If you discover an unknown waste, please contact your HW Media Manager for guidance.

37) X-2 OR X-3 MATERIALS (CHEMICALS & RESINS)

X-2 and X-3 materials must be de-militarized prior to disposal. NAVFAC MIDLANT ESD will provide this service for an additional cost. Contact NAVFAC MIDLANT ESD to schedule a pickup at.

PLEASE NOTE:

To ensure proper handling, on the 1348-1A indicate the items are X-2 or X-3 material.

APPENDIX 1: POINTS OF CONTACT***Hazardous Waste and Pollution Prevention Media Managers***

Director	341-0400
Hazardous Waste Media Manager By Installation	
Naval Station Norfolk, Craney Island	341-0380
Yorktown, Cheatham Annex, St. Julien's Creek Annex, Southgate Annex, Scott Creek Annex, NMCP	341-0405
Joint Expeditionary Base Little Creek – Fort Story	341-0403
NAS Oceana, Dam Neck Annex, Northwest, Fentress, Dare County	341-0409
Senior Program Manager-All sites	341-0408
Environmental Pollution Prevention Media Managers	341-0402 and 341-0364

Installation Environmental Compliance Departments

Joint Expeditionary Base Little Creek – Fort Story	
Director	462-5350
Lead Environmental Protection Specialist	462-5361
Environmental Protection Specialist	462-5355
Environmental Protection Specialist	462-5353
Environmental Protection Specialist	462-5356
Naval Station Norfolk	
Director	341-0523
Lead Environmental Protection Specialist	341-0516
Environmental Protection Specialist	341-0520
Environmental Protection Specialist	341-0515
Environmental Protection Specialist	341-0511
Environmental Protection Specialist	341-0517
NAS Oceana/ Dam Neck Annex	
Director	433-3437
Lead Environmental Protection Specialist	433-3435
Environmental Protection Specialist (NW, Dare County), STKWING)	433-3461
Environmental Protection Specialist (Dam Neck)	433-3434
Environmental Protection Specialist (VACAPES, STKWING)	433-2131
Environmental Protection Specialist (AIMD, NEX, MWR)	433-3439
NWS Yorktown / Cheatham Annex/Yorktown Fuels	
Director	887-4086
Lead Environmental Protection Specialist	887-4881
Environmental Protection Specialist	887-4958
Environmental Protection Specialist	887-4095
NSA Hampton Roads	
Director	836-1862
Environmental Protection Specialist	421-8114
NSA Norfolk Naval Shipyard and Annexes	
Director	396-8270
Environmental Protection Specialist	341-0514

Environmental Services Department

NAVFAC MIDLANT ESD	341-0460/0412 Fax:341-0436
Environmental Operations Director	341-0473
NAVFAC MIDLANT HWO Supervisor	341-0410
NAVFAC MIDLANT HWO Profile Chemist	341-0471

Appendix 1: Points of Contact

Asbestos & Insulation Branch	341-0474
NAVFAC MIDLANT Lab Services (LS)	341-0462, 341-0465 (fax)
NAVFAC MIDLANT Oil Recovery	341-0412
NAVFAC MIDLANT Pest Services	341-0412, 341-0460

Regional Solid Waste and Recycling Program

Regional Director	341-1137
NAS Oceana / Dam Neck	433-2454
Joint Expeditionary Base Little Creek – Fort Story	462-7401
Naval Station Norfolk	445-8700
NSA Norfolk Naval Shipyard and Annexes	635-6310
NWS Yorktown / Cheatham Annex	887-4381
QRP-Qualified Recycling Program (Spent Brass)	433-2454 / 341-1136 / 636-4076

Defense Depot Norfolk Virginia (DDNV)

Note: headquartered on Naval Station Norfolk but services the Mid-Atlantic Region	
Compressed Gas Cylinder Yard	443-3142
Cylinder Technical Support	443-3385 449-7880 (cell)
Material Offload Scheduling (Trucks)	443-3131 or 443-3146
Material Offload Scheduling (Ships)	443-3120
X-2, X-3 Material Issue	443-3150

DLA Aviation

Note: headquartered on Naval Station Norfolk but services the Mid-Atlantic Region	
Cylinder Information	804-279-5203
Cylinders with ODS	DSN 695-5203

DLA Disposition Services

Note: headquartered on Naval Station Norfolk but services the Mid-Atlantic Region	
St. Juliens Creek Division	396-0137 xt.13
Re-sale Information	444-5826
Hazardous Material Turn-in (Receiving)	445-4450/445-9476
Waste Disposal – Supervisor	444-7685
Waste Disposal – Specialist	445-4077
Waste Disposal – Specialist	445-2976
Electronic Waste (e-waste)	445-5115/2412

Fleet Industrial Supply Center (FISC)

Note: headquartered on Naval Station Norfolk but services the Mid-Atlantic Region	
LOGISTICS SUPPORT CENTER	443-1211
HAZMINCEN – NORFOLK LF-50 (HM support provided to Little Creek)	444-2024
HAZMINCEN – OCEANA Bldg. Z-826 (HM support provided to Northwest)	433-3730
HAZMINCEN – Ft. Eustis	878-2781
Reuse Store Facility (X-218)	445-7942
Reuse Store – Cylinder Issue	444-1810, 444-4528
Hazardous Material Program Office (HMPO) East	443-1312

Consolidated Hazardous Material Reutilization & Inventory Management Program (CHRIMP)

CHRIMP Afloat Project Manager	443-2549
CHRIMP Afloat Site Manager	443-2411
CHRIMP Afloat Support Bldg. W-143 (CG/DD/DDG/FFG/LPD)	443-2411/1311/2546/2547/2558/2410
CHRIMP Afloat Support Bldg. X-218 (AOE/CVN/LHA/LHD)	444-4789/0593
CHRIMP Afloat Support for Joint Expeditionary Base Little Creek – Fort Story West provided by HMPO office Norfolk (LSD, ARS/PC)	443-2411/1311/2546/2547/2558/2410

Other Commands/Departments

Commander Navy Region Mid-Atlantic Safety	322-2926 or 2927
NEMPU2	444-7671
Naval Air Technical Data & Engineering Service Command (NATEC)	https://mynatec.navair.navy.mil
PWC Maintenance Department – Norfolk	341-0788
PWC Transportation Department – Norfolk	341-0761
Port Operations	444-7345
Ship Support Office-Norfolk/JEFLCFS	445-7447/462-4090
<u>Rag Recycling Contract Administrator</u>	<u>717-605-6856</u>
Radiation Safety Office (RASO)	887-7610/887-4692

APPENDIX 2: INSTRUCTION FOR DD FORM 1348-1A, or HICSWIN DD FORM 1348-1

<http://www.dispositionservices.dla.mil/turn-in/usable/dd1348-1a.pdf>

I. GENERAL SAFE HANDLING GUIDANCE

1. Segregate material according to Federal Stock Class (FSC), compatibility and container size.
2. Segregate used from unused HM/HW.
3. Place leaking HM in appropriate salvage containers (5, 55, or 85 gallon).
4. Properly complete four copies of DD Form 1348-1A or HICSWIN 1348-1 for all waste turn-ins. Fax one copy to MIDLANT Environmental Services Desk (FAX: 341-0436) as follows:

II. REQUIREMENTS FOR DOCUMENTATION

NAVFAC MIDLANT, DRMO, & FISC require the following information on DD form 1348-1a, or Form 1348-1 created in HICSWIN:

- Block: 02. Activity generating the waste, (Ex. Building # or Command/Ship & Hull #).
03. Activity accepting the waste (Ex. MIDLANT, DRMO, FISC, or UIC, etc.)
04. Mark for "DISPOSAL," "RECYCLING," "REUSE," "MIDLANT," "DRMO," "FISC," etc.
17. Generic name of product (listing any known contaminants).
18. Type of container (Ex. 55 gallon, 5 gallon, 10 -lb. Box)
- 19 (or 25-29) Number of containers
20. Total Weight of Shipment (May leave blank if turned into MIDLANT, they will weigh the materials MIDLANT takes custody of.)
24. Unit Identification Code (UIC) Number.
25. FSC and NIIN (The National Stock Number). Include the manufacturer.
- Open Area Additional data - Enter MSDS or profile number, if known.
- Open Area Job Order Number (JON) (required for non-FLT activities)
- Open Area A point of contact (who has knowledge about the process that generated the waste) and phone number and email address.
- Open Area Indicate that waste is from a SAA or HWAA and include date of oldest drum.

Open Area All activities not using HICSWIN, list the process that generated the waste, (Ex. painting, degreasing, etc.)

Open Area Words "Approved for transfer" and a qualified signature

Open Area FISC ECAP stamp approval noted.

In addition to the general requirements, MIDLANT upon receipt of materials will add the following information:

Open Area Unique drum control number or barcode

22 MIDLANT will sign for custody of material (one copy return to client)

23 MIDLANT will enter date of acceptance.

For off-site transportation only:

16 MIDLANT will enter the DOT proper shipping name, UN or NA code, packing group, and EPA codes when appropriate.

20 When appropriate enter weight.

Open Area Emergency Response Guide number

In addition to the general requirements listed above, DRMO also requires the following information:

Boxes 52-53 Fund Code (Command Specific)

65-66 Demilitarization Code

74-80 Unit Price

Open Area DOT Certification statement: "The HM is packaged in containers as prescribed in DOT HM Regulations 49 CFR parts 170-189." Please note that original containers meet this certification.

Blank 1348-1A Form

DD FORM 1348-1A (BPT), JUL 91 ISSUE RELEASE/RECEIPT DOCUMENT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100					
24. DOCUMENT NUMBER & SUFFIX (30-41)															1. TOTAL PRICE															2. SHIP FROM															3. SHIP TO																																																											
25. NATIONAL STOCK NO. & ADD (8-22)															UNIT PRICE															DOLLARS															CTS																																																											
26. RIC (4-6) UI (23-24) CITY (25-28) COUNTRY (29-31) DIST (32-33) UP (74-80)															DOLLARS															CTS															4. MARK FOR																																																											
27. ADDITIONAL DATA															5. DOC DATE															6. NMFC															7. FRT RATE															8. TYPE CARGO															9. PS																													
															10. QTY. REC'D															11. UP															12. UNIT WEIGHT															13. UNIT CUBE															14. UFC															15. SL														
															16. FREIGHT CLASSIFICATION NOMENCLATURE															17. ITEM NOMENCLATURE																																																																										
															18. TY CONT															19. NO CONT															20. TOTAL WEIGHT															21. TOTAL CUBE																																												
															22. RECEIVED BY															23. DATE RECEIVED																																																																										

1

S/N 0102-LF-115-3800

DD FORM 1348-1A (BPT), JUL 91 ISSUE RELEASE/RECEIPT DOCUMENT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100					
24. DOCUMENT NUMBER & SUFFIX (30-41)															1. TOTAL PRICE															2. SHIP FROM															3. SHIP TO																																																											
25. NATIONAL STOCK NO. & ADD (8-22)															UNIT PRICE															DOLLARS															CTS																																																											
26. RIC (4-6) UI (23-24) CITY (25-28) COUNTRY (29-31) DIST (32-33) UP (74-80)															DOLLARS															CTS															4. MARK FOR																																																											
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S/N 0102-LF-115-3800

APPENDIX 3: SPILL REPORTING PROCEDURES

1. In the event of a spill of oil or a hazardous substance, Navy personnel may take action to stop, reduce, or contain the spill, provided they have the proper training and equipment to do so without risking personal injury/contamination.

2. Report **ALL** spills to the Emergency Communications Center (ECC) immediately. Notify the ECC if any cleanup assistance required (i.e. MIDLANT Spill Response Team).

Naval Station Norfolk	444-3333
NAS Oceana	433-9111
Dam Neck Annex	433-9111
NWS Yorktown	887-4911
JEB Little Creek	462-4444
JEB Ft. Story	422-7141
NALF Fentress	433-9111
DFSP Craney Island	396-3333
NNSY	396-3333
ROTHR New Kent	887-4911
St. Helena Annex	911
NSA Northwest	911
Dare County	911
NMC Portsmouth	396-3333

ECC will dispatch the appropriate station Command Duty Officer (CDO) and the Station Fire Department to the spill location. Upon arrival of the Fire Department, the command who reported the spill will relay all of the pertinent information to the Fire Department, who will serve as the Incident Commander (IC) for the duration of the spill containment, clean up and investigation process. The following information should be obtained:

INFORMATION REQUIRED WHEN REPORTING A SPILL

Name of person reporting the spill.	Quantity spilled
Command of person reporting the spill.	Cause of spill
Location of spill, Date & time of Spill	Substance spilled
Weather conditions including wind direction and speed and cloud cover	
Slick description including color and size	
Clean-up information: method, time and person(s) performing the clean up.	
Spill Cleanup assistance requirements	
Notifications made to other commands.	

3. The National Response Center (NRC) will be notified by the Emergency Communication Center (ECC). The command responsible for spill must contact the Installation Environmental Office to ensure the spill information is available.

4. The command responsible for the spill is required to report the incident, by sending a Navy spill message, in accordance with COMNAVBASENORVA/SOPA(ADMIN)HAMPINST 5400.1F and OPNAVINST 5090.1C, 5090.3, and 3100.6H. CHECK WITH SPILL PM.

5. If there are any questions on spill reporting requirements, call your Environmental Media Manager or Installation Environmental Office for more information. Personnel that fail to report a spill or who submit false or misleading information may be subject to criminal sanctions, including fines and/or imprisonment.

APPENDIX 4: CONTAINER PROCUREMENT & MARKING DEVICES

CONTAINER PROCUREMENT

If original containers cannot be used to store the HW, acceptable containers may be obtained by the following methods:

1. The RRP has free, used drums on a limited basis. Contact the RRP for availability.
2. New or reconditioned drums can be purchased through FISC, contact FISC Customer Service for more details.
 - 55 gallon steel with bung openings: NSN 8110-00-292-9783
 - 55 gallon steel with open tops: NSN 8110-00-030-7780
 - 55 gallon plastic with bung opening: NSN 8110-01-150-0677
3. Other containers may be used if they meet the DOT container requirements. Any container used to store a hazardous waste must be made of or lined with materials, which will not react with, and are compatible with the item(s) to be stored inside them. The container must possess the ability to hold the waste without being impaired. The containers must be able to be secured/sealed to ensure the contents will not spill during routine storage or transportation.
4. Empty drums can be obtained through the NAVFAC MIDLANT ESD who will provide containers as a last resort with a DD- 1348.

MARKING DEVICES

Paint Pens may be used to mark the containers with the proper information. Ordering information for Paint Pens is listed below:

- White Paint Pen NSN 7520-01-207-4149
- Red Paint Pen NSN 7520-01-207-4161
- Yellow Paint Pen NSN 7520-01-207-4165
- Gold Paint Pen NSN 7520-01-207-4166

APPENDIX 5: SITE GUIDANCE for SATELLITE ACCUMULATION AREAs

Enclosure: Inspection Checklist for Satellite Accumulation Area (SAA)

HW Satellite Accumulation Area

CHECK TO ENSURE

- Drums are kept closed except when adding waste
- HW labels are facing outward
- Secondary containment is clean (if applicable)
- Max Capacity: 55-gallons, regardless of the # of HW containers
- When HW containers are 75% full, arrange for pickup (341-0412/0460)
- Do not date drum until is full (3 days to move to <90 days or dispose)

HW Container ***Legally Required*** Label



Please call the Hazardous Waste Manager with any HW issues: _____

If an uncontrolled spill occurs , please call _____

SATELLITE ACCUMULATION AREA (SAA) CHECKLIST

INSPECTOR	INSPECTION DATE/TIME	AREA
HW CUSTODIAN	PHONE NUMBER	HW TRAINING DATE
		CODE/UNIT
All checklist questions must be answered. All "NO" answers require the violation to be noted and corrected unless otherwise noted. Comment may include violation description, action, date action completed, and other pertinent details.		
SATELLITE ACCUMULATION AREA Compliance Questions	Circle Answer	Comment
1. Is the SATELLITE ACCUMULATION AREA near the point of generation and under control of the operator of the process generating the waste?	Yes No	
2. Is the area free of any spills or container overfills (waste product on the container lid) and is good housekeeping maintained?	Yes No	
3. Is a fire extinguisher located and available within 50 feet and is the inspection current?	Yes No	
4. Is spill control equipment (Example: absorbents) available at the SATELLITE ACCUMULATION AREA?	Yes No	
5. Is the HW operator/site custodian annual training up to date?	Yes No	
6. Is a "SATELLITE ACCUMULATION AREA" sign with Primary and Alternate emergency contact information posted at the site?	Yes No	
7. Is a "NO SMOKING" Sign posted at the Satellite Accumulation Area?	Yes No	
If there is no hazardous waste currently stored at the site answer N/A for the remainder of checklist.		
8. Is the total volume of hazardous waste 55 gallons or less (OR 1 quart or less of acutely hazardous waste)?	Yes No N/A	
9. Are containers kept sealed at all times except when waste is added?	Yes No N/A	
10. Are containers in good condition (non-leaking or non-corroded) and compatible with the waste stored in them? (Example of incompatibility: corrosive waste in a metal drum).	Yes No N/A	
11. HW Labeling Checks	a. does each HW container have a HW label?	Yes No N/A
	b. clearly visible and facing out for inspection?	Yes No N/A
	c. include the words, "HAZARDOUS WASTE?"	Yes No N/A
	d. include specific contents of the waste(s)?	Yes No N/A
	e. include the accumulation date? (Containers must only be dated once the total volume of the SATELLITE ACCUMULATION AREA reaches 55 gallons, or one quart of acute HW, then all the wastes must be removed within 72 hours).	Yes No N/A
12. If the Satellite Accumulation Area container (I.E. 55 Gallon) has reached capacity has the container been dated and moved to the Hazardous Waste Accumulation Area site within 72 hours?	Yes No N/A	

For Environmental Personnel Only:

Check Inspection Type: Oversight___; Setup___; Closeout___

APPENDIX 6: SITE GUIDANCE for HAZARDOUS WASTE ACCUMULATION AREA

Enclosure: Hazardous Waste Accumulation Area Inspection Checklist for Containers Less Than or Equal to 119 Gallons.

HW (<90 Day) Accumulation Area

CHECK TO ENSURE

- Drums are kept closed except when adding waste
- HW labels are facing outward
- Secondary containment is clean
- Contact Environmental Services (341-0412/0460) to arrange HW container pickup no later than the 45th day from **ASD**
- Site **MUST** be inspected every 7 days (records kept for 3 years)
- Aisle space **MUST** allow for removal of HW and a 360 degree inspection
- No limit on volume storage

HW Container *Legally Required* Label

Must have a start date if waste is placed in drum
(ASD)

Must identify type of waste



HAZARDOUS WASTE

ACCUMULATION START DATE _____

CONTENTS _____

HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

Please call the Hazardous Waste Manager with any HW issues: _____

If an uncontrolled spill occurs , please call _____

HAZARDOUS WASTE ACCUMULATION AREA (HWAA) CHECKLIST

INSPECTOR	INSPECTION DATE/TIME	AREA
HW CUSTODIAN	PHONE NUMBER	HW TRAINING DATE
		CODE/UNIT
All checklist questions must be answered. All "NO" answers require the violation to be noted and corrected unless otherwise noted. Comment may include violation description, action, date action completed, and other pertinent details.		
HAZARDOUS WASTE ACCUMULATION AREA Compliance Questions	Circle Answer	Comment
1. Are good housekeeping standards employed?	Yes No	
2. Is the area free of any spills or container overfills (waste product on the container lid)?	Yes No	
3. Is a fire extinguisher located and available within 50 feet and is Inspection current?	Yes No	
4. Is spill control equipment (examples: absorbents) available at the Site?	Yes No	
5. Are HAZARDOUS WASTE inspections conducted and properly documented every 7 days?	Yes No	
6. Are HAZARDOUS WASTE inspection records kept for 3 years?	Yes No	
7. Is the HW operator/site custodian annual training up to date?	Yes No	
8. Is a "HAZARDOUS WASTE ACCUMULATION AREA" sign with Primary and Alternate emergency contact information posted at the site?	Yes No	
9. Is a "NO SMOKING" sign posted?	Yes No	
If there is no hazardous waste currently stored at the site answer N/A for the remainder of checklist.		
10. Are HAZARDOUS WASTE containers in good condition (non-leaking or non-corroded) and compatible with the waste stored in them?	Yes No N/A	
11. For hazardous waste containing volatile organics, are individual HAZARDOUS WASTE containers either (circle applicable items) a. less than 26 gallons? b. 26 or greater but less than 119 gallons; and DOT approved? c. Is air emissions documentation allowing non-DOT containers maintained with the inspection records?	Yes No N/A Yes No N/A Yes No N/A	
12. Are incompatible wastes separated by a wall, berm, or overpack to prevent mixing?	Yes No N/A	
13. Are HAZARDOUS WASTE containers kept sealed except when waste is being added or removed?	Yes No N/A	
14. HW Labels	a. does each HW container have a HW label?	Yes No N/A
	b. clearly visible and facing out for inspection?	Yes No N/A
	c. include the words, "HAZARDOUS WASTE?"	Yes No N/A
	d. include specific contents of the waste(s)?	Yes No N/A
	e. include the accumulation date?	Yes No N/A
15. Are old Hazardous Waste labels & markings removed?	Yes No N/A	
16. Date of oldest HW container in the HWAA.		
17. Has a pickup request been submitted for all HW containers that have been accumulating for more than 45 days?	Yes No N/A	
18. Are adequate aisle spaces maintained for incident response?	Yes No N/A	

For Environmental Personnel Only: Check Inspection Type: Oversight___; Setup___; Closeout___

APPENDIX 7: SITE GUIDANCE for UNIVERSAL WASTE ACCUMULATION AREA

Enclosure: Universal Waste Accumulation Area (UWAA) Inspection Checklist

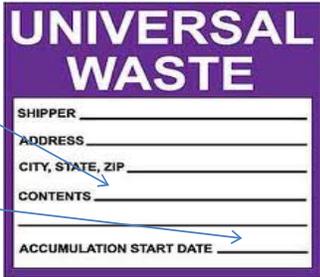
Universal Waste Accumulation Area

CHECK TO ENSURE

- Drum lids are secure and boxes sealed
- UW labels are facing outward
- **ASD** reflects the date when item is put at site
- Arrange for pickup (341-0412/0460) no later than the 270th day (9 months) from **ASD**

UW Container *Legally Required* Label

Must identify type of waste



ASD

Please call the HW Manager with any HW issues:

If an uncontrolled spill occurs , please call _____

UNIVERSAL WASTE ACCUMULATION AREA (UWAA) CHECKLIST

INSPECTOR	INSPECTION DATE/TIME	AREA
HW CUSTODIAN	PHONE NUMBER	HW TRAINING DATE
		CODE/UNIT
All checklist questions must be answered. All "NO" answers require the violation to be noted and corrected unless otherwise noted. Comment may include violation description, action, date action completed, and other pertinent details.		
UNIVERSAL WASTE ACCUMULATION AREA Compliance Questions	Circle Answer	Comment
1. Is the area free of any spills or container overfills (waste product on the container lid)?	Yes No	
2. Area good housekeeping standards employed?	Yes No	
3. Is a fire extinguisher located and available within 50 feet and is Inspection current?	Yes No	
4. Is spill control equipment (examples: absorbents) available at the Site?	Yes No	
5. Is the HW operator/site custodian annual training up to date?	Yes No	
6. Is a "UNIVERSAL WASTE ACCUMULATION AREA" sign with Primary and alternate emergency contact information posted at the site?	Yes No	
7. Is a "NO SMOKING" sign posted?	Yes No	
If there is no Universal Waste currently stored at the site answer N/A for the remainder of checklist.		
8. Are Universal Waste containers kept sealed except when waste is being added or removed?	Yes No N/A	
9. Are Universal Waste containers in good condition (non-leaking or non-corroded) and compatible with the waste stored in them?	Yes No N/A	
10. Is each Universal Waste item or the container for the Universal Waste(s) labeled or marked with one of the following phrases? Circle the applicable item:		
a. "Universal Waste – Battery(ies)", or	Yes No N/A	
b. "Universal Waste – Pesticide(s)", or	Yes No N/A	
c. "Universal Waste – Mercury Containing Equipment", or	Yes No N/A	
d. "Universal Waste – Lamp(s)"	Yes No N/A	
11. Is each Universal Waste container for the universal waste(s) labeled with the accumulation start date?	Yes No N/A	
12. Are adequate aisle spaces maintained for incident response?	Yes No N/A	
13. Date of oldest UW container in the UWAA.		
14. Has a pickup request been submitted for all UW containers that have been accumulating for no more than 270 days (9 months)?	Yes No N/A	
15. Is the Universal Waste segregated/packaged and/or stored correctly? (i.e. Waste lithium batteries individually wrapped/packaged).	Yes No N/A	

For Environmental Personnel Only:

Check Inspection Type: Oversight___; Setup___; Closeout___

APPENDIX 8: PROCEDURE FOR ESTABLISHING A JOB ORDER NUMBER

In order to provide service to any customer, a job order number (JON) must be established with the NAVFAC Midlant Financial Management Business Line, Accounts Receivable Department.

To establish a job order number the customer must provide a Funding Document (NAVCOMPT form 2275) or a Requisition & Invoice (form DD-1149). The funding document should state under the description of work "MIDLANT ENVIRONMENTAL SERVICES " at minimum and should list the type of work requested. Forms may be obtained at the comptrollers' office for each command (phone: 341-1325/1318). A copy of the completed funding document must be sent to NAVFAC-MIDLANT (Accounts Receivable), FAX # (757) 341-1318. The NAVFAC MIDLANT Accounts Receivable Department can assign a job order as soon as the funding document is received. Work may be requested as soon as a valid JON is established.

Call2Recycle
Rechargeable Battery Recycling Program Management Guidelines

This program is designed to recycle your old, rechargeable batteries from items such as cell phones, lab tops, power tools, etc. at no costs to your facility. Rechargeable batteries meet the definition of Universal Waste and must be properly managed during accumulation and sent for proper disposal or recycling.

Contact your installation Hazardous Waste (HW) Media Manager to get started with your own Call2Recycle collection box.

- 1) The HW Media Manager will provide the proper tools and training to successfully manage and recycle your rechargeable batteries. In addition to the provided on-site training, web based training may be accessed at <https://navfac.ecatts.com/start>.
- 2) A POC will be designated as the responsible person for the collection box at the time it is established. The name and number of this POC will be documented on a site specific sign provided by the HW Media Manager. **Only this POC and those trained on the Call2Recycle program will be allowed to bag and place batteries into the collection box.** The sign also provides the POC with a battery recycling guide for reference.
- 3) Each battery shall be packaged in accordance with the directions on the box. Leaking or damaged batteries cannot be recycled and should be disposed of as HW. Your HW Media Manager can assist with this process. Adhering to these directions will help ensure safe storage.
- 4) The box must be dated when the very first battery is placed in it. Once the collection box is full or the 270 day limit has been reached (whichever comes first), tape the box closed and ship through UPS.
- 5) The collection boxes are already properly labeled and marked to comply with DOT and EPA regulations so additional labels or markings will not be required.
- 6) Site inspections will be performed quarterly by Environmental to check for site safety, proper storage and correct batteries.
- 7) Please coordinate with the HW Media Manager to receive new collection boxes.

HW Compliance Director	341-0400
Hazardous Waste Media Manager By Installation	
Naval Station Norfolk, Craney Island, NSA Norfolk	341-0380
NWS Yorktown, Cheatham Annex, New Kent, St. Julien's Creek Annex, Southgate Annex, Scott Creek Annex, NMCP	341-0405
Joint Expeditionary Base Little Creek – Fort Story	341-0403
NAS Oceana, Dam Neck Annex, Northwest, Fentress, Dare County	341-0409

* Central POC for questions or issues is Mike Therrien (341-0409).
 * Call2Recycle center - military@call2recycle.org or 1-877-2-RECYCLE

SECTION 01 58 00

PROJECT IDENTIFICATION

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.

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

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

Preliminary Drawing Indicating Layout and Text Content; G

Sign Legend Orders; G

1.3 PROJECT SIGN

Prior to initiating any work on site, provide one project identification sign at the location designated. Construct the sign in accordance with project sign detail, which can be downloaded at: <http://www.wbdg.org/ccb/NAVGRAPH/graphoc.pdf>. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site.

1.3.1 Project Identification Signboard (Navy)

A project identification signboard shall be provided in accordance with attached Plates 1, 3, and 4. Provide preliminary drawing indicating layout and text content. The signboard shall be provided at a conspicuous location on the job site where directed by the Contracting Officer.

- a. The field of the sign shall consist of a 4 by 8 foot sheet of grade B-B medium density overlaid exterior plywood.
- b. Lumber shall be B or better Southern pine, pressure-preservative treated in accordance with AWPA C1 and AWPA C2. Nails shall be aluminum or galvanized steel.

- c. The entire signboard and supports shall be given one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint. The lettering and sign work shall be performed by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles shall be as indicated. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.
- d. Use spray applied automotive quality high gloss acrylic white enamel paint as background for the NAVFAC logo. NAVFAC logo shall be an applied 2 mil film sticker/decal with either transparent or white background or paint the logo by stencil onto the sign. The weather resistant sticker/decal film shall be rated for a minimum of 2-year exterior vertical exposure. The self-adhering sticker shall be mounted to the sign with pressure sensitive, permanent acrylic adhesive. Shop cut sticker/decal to rectangular shape and provide pull-off backing sheet on adhesive side of design sticker for shipping.
- e. Sign paint colors (manufacturer's numbers/types listed below for color identification only)
 - (1) Blue = To match dark blue color in the NAVFAC logo.
 - (2) White = To match Brilliant White color in the NAVFAC logo.
- f. NAVFAC logo must retain proportions and design integrity. NAVFAC logos in electronic format may be obtained from the NAVFAC web portal via the following link:
https://portal.navy.mil/portal/page?_pageid=181,3465071&_dad=portal&_schema=p
Use the following to choose color values for the paint to be used:
 - (1) Dark Blue = equivalent to CMYK values 100, 72, 0, 8 .
 - (2) Light Blue = equivalent to CMYK values 69, 34, 0, 0.
 - (3) Cyan = equivalent to CMYK values 100, 9, 0, 6.
 - (4) Yellow = equivalent to CMYK values 0.9,94, 0.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

VERIFY W/ CONTRACTING OFFICER IF PROJECT IS AN ARRA PROJECT. FOR ARRA PROJECTS, ADD SIGNAGE AT TOP OF SIGN. SEE PLATES 8 AND 9 FOR SIGNAGE AND DETAILS.

MITERED CORNER
4"x4" [89mmx89mm]
PRESSURE TREATED POST;
COLOR: 'DARK BLUE', TYP.

11.25 [286mm] DIAMETER
CNIC LOGO AVAIL: https://portal.navfac.navy.mil/portal/page?_pageid=181,3465071&_dad=portal&schema=PORTAL

2" [50mm] LETTERING
CENTERED (ITALICIZED)

PAINTED FIELD; COLOR, 'WHITE'

3" [75mm] LETTERING
CENTERED

2" [50mm] LETTERING
CENTERED

2.5" [64mm] LETTERING
CENTERED (ITALICIZED)

2" [50mm] LETTERING
CENTERED

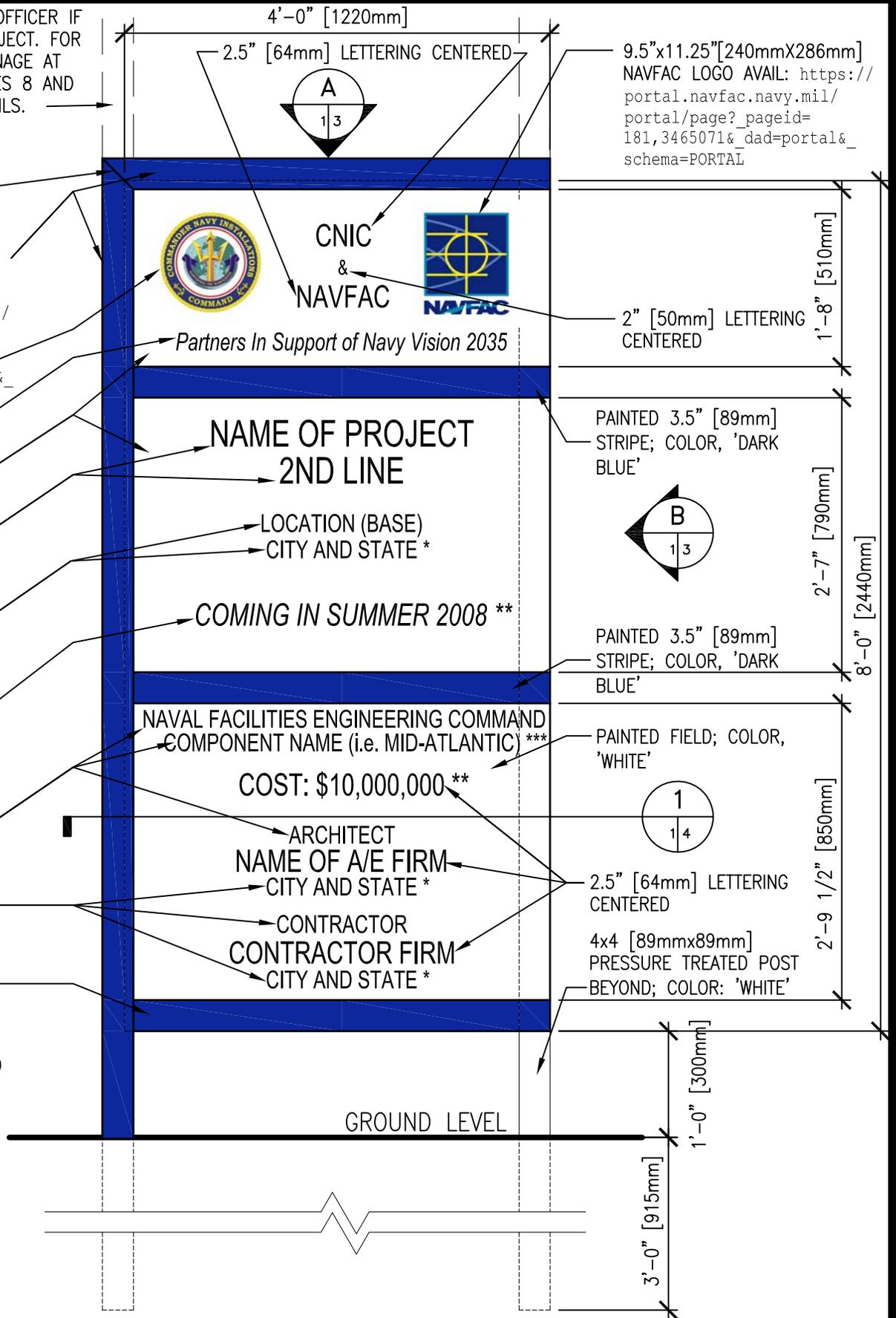
2" [50mm] LETTERING
CENTERED

PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'

NOTES:
1. PAINT ALL OTHER WOOD SURFACES WITH ONE COAT EXT. PRIMER AND TWO COATS GLOSS WHITE ENAMEL.

2. ALL LETTERING SHALL BE EVENLY SPACED.
3. LETTER STYLE, 'ARIAL', COLOR 'DARK BLUE'. TYPICAL FOR ALL LETTERING.

*-ABBREVIATE STATE
**-CONFIRM USE WITH CONTRACTING OFFICER
***-VERIFY NAME WITH CONTRACTING OFFICER.



9.5"x11.25"[240mmX286mm]
NAVFAC LOGO AVAIL: https://portal.navfac.navy.mil/portal/page?_pageid=181,3465071&_dad=portal&schema=PORTAL

2" [50mm] LETTERING
CENTERED

PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'

PAINTED 3.5" [89mm]
STRIPE; COLOR, 'DARK
BLUE'

PAINTED FIELD; COLOR,
'WHITE'

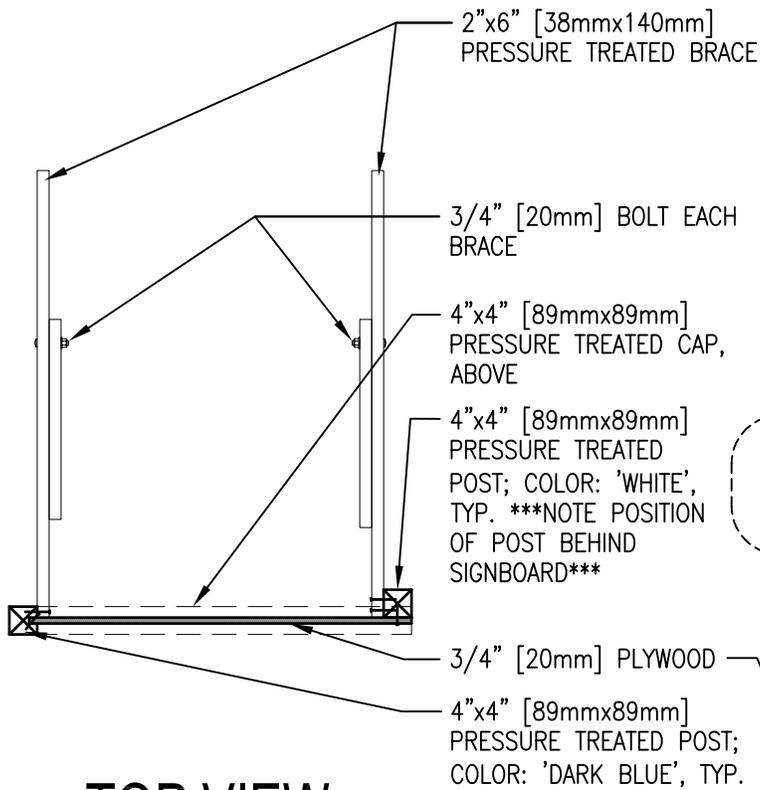
2.5" [64mm] LETTERING
CENTERED

4x4 [89mmx89mm]
PRESSURE TREATED POST
BEYOND; COLOR: 'WHITE'

PROJECT IDENTIFICATION SIGNBOARD

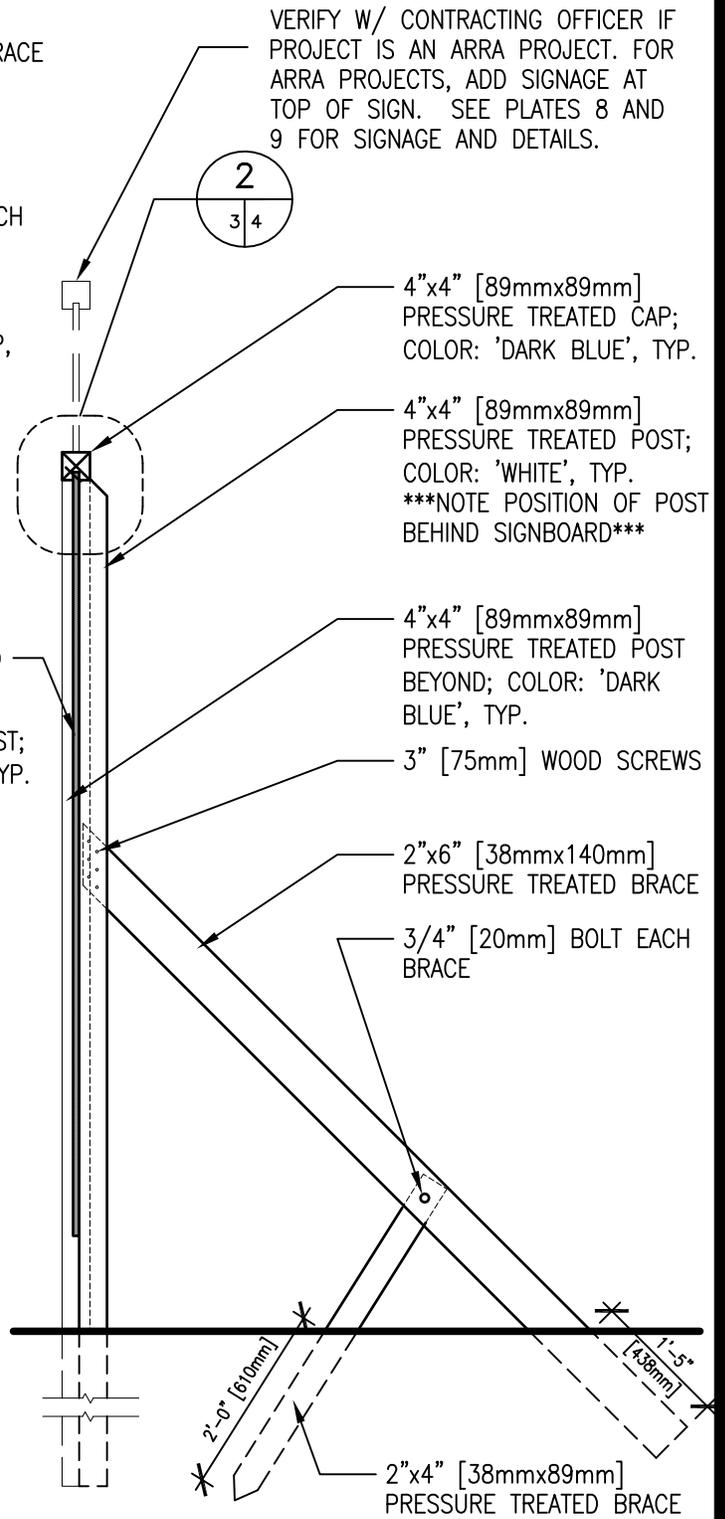
SCALE: 3/4" = 1'-0"

PLATE 1



A TOP VIEW
SCALE: 1/2" = 1'-0"

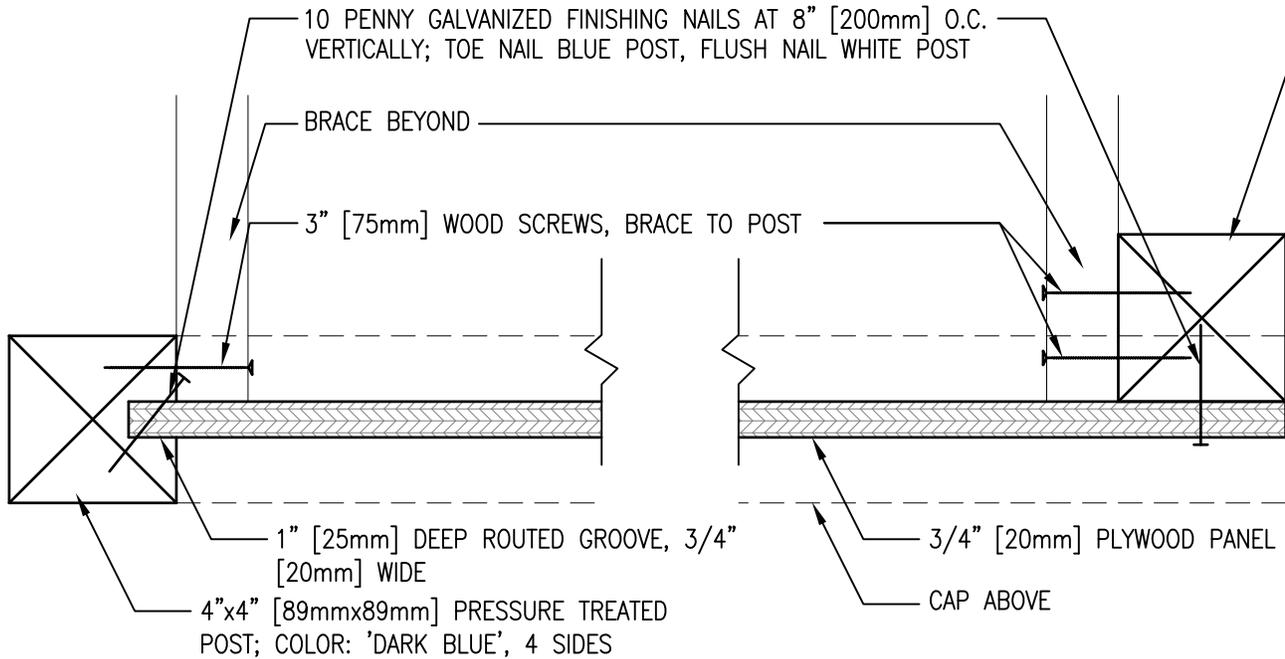
- NOTES:
1. POSTS AND BRACES SHALL BE PRESSURE TREATED.
 2. ALL FASTENERS SHALL BE ZINC COATED.
 3. BRACING IS REQUIRED IN ALL SOIL CONDITIONS AND HIGH WIND ENVIRONMENTS.



B SIDE VIEW
SCALE: 1/2" = 1'-0"

PROJECT IDENTIFICATION SIGNBOARD SUPPORT DETAILS

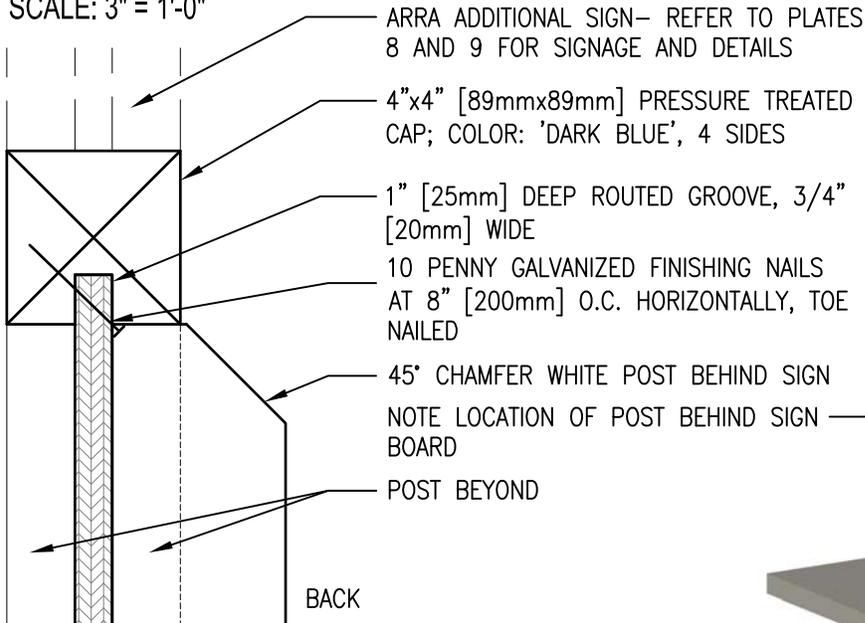
4"x4" [89mmx89mm] PRESSURE TREATED POST; COLOR: 'WHITE', TYP. ***NOTE POSITION OF POST BEHIND SIGNBOARD***



1
1,2 4

PLAN SECTION

SCALE: 3" = 1'-0"



FRONT

BACK



3
2 4

ISO VIEW

SCALE: NONE

PROJECT IDENTIFICATION SIGNBOARD SECTIONS

PLATE 4

SECTION 01 78 00

CLOSEOUT SUBMITTALS
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.

ASTM INTERNATIONAL (ASTM)

ASTM E1971 (2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

GREEN SEAL (GS)

GS-37 (2012) Cleaning Products for Industrial and Institutional Use

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-300-08 (2009, with Change 2) Criteria for Transfer and Acceptance of DoD Real Property

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-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Final Cleaning
Spare Parts Data

SD-07 Certificates

Certification of EPA Designated Items

SD-08 Manufacturer's Instructions

Preventative Maintenance
Condition Monitoring (Predictive Testing)
Inspection
Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings
Certification of EPA Designated Items; G
Interim Form DD1354; G
Checklist for Form DD1354; G
NAVFAC Sustainable & Energy Data Record Card; G

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions. The final CAD record drawings must consist of one set of electronic CAD drawing files in the specified format, 2 sets of prints, and one set of the approved working Record drawings.

1.3.1.1 Government Furnished Materials

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

1.3.1.2 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution 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. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. 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 average depth below the surface of each run.

- 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 size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.3.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints 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.

1.3.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only employ personnel proficient in the preparation of CADD drawings to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, prepare them using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings. Accomplish additions and corrections to the contract drawings using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCad format compatible with a Windows operating system. The electronic files will be supplied on optical disk. Provide all program files and hardware necessary to prepare final record drawings. The Contracting Officer will review final record drawings for accuracy and return them to the Contractor for required corrections, changes, additions, and deletions.

- a. Provide CADD "base" colors of red, green, and blue. Color code for changes as follows:
 - (1) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.
 - (2) Additions (Green) - Added items, lettering in notes and leaders.
 - (3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.
- b. Rename the Contract Drawing files in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Use only those renamed files for the Marked-up changes. All changes shall be made on the layer/level as the original item.
- c. When final revisions have been completed, show the wording "RECORD DRAWINGS / AS-BUILT CONDITIONS" followed by the name of the Contractor in letters at least 3/16 inch high on the cover sheet drawing. Mark all other contract drawings either "Record" drawing denoting no revisions on the sheet or "Revised Record" denoting one or more revisions. Date original contract drawings in the revision block.
- d. Within 10 days after Government approval of all of the working record drawings for a phase of work, prepare the final CADD record drawings for that phase of work and submit two sets of blue-lined prints of

these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 10 days of substantial completion of all phases of work, submit the final record drawing package for the entire project. Submit one set of electronic files on optical disk, one set of mylars, two sets of blue-line prints and one set of the approved working record drawings. They must be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final record drawing files and marked prints as specified will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final record drawings must be accomplished before final payment is made to the Contractor.

1.3.1.5 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 one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit Two 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. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.3.3 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), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. 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. Supply items of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTATIVE MAINTENANCE

Submit Preventative 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 preventative 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 or biobased content, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, total value of biobased content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled and biobased 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 this project. At least 30 days before the planned pre-warranty conference, submit one set 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. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. 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 period.

- a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.
- b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.
- c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.7.3 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.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	
Address	
Telephone number	
Warranty contact	
Address	
Telephone number	
Warranty response time priority code	
WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.	

1.8 COMMISSIONING

1.8.1 Building Commissioning

All contract requirements for building commissioning shall be completed prior to contract completion.

1.8.2 HVAC Commissioning

All contract requirements of Section 01 91 00.00 40 COMMISSIONING must be fully completed, including all testing concurrent with Building Commissioning. All contract requirements of Section 23 05 93 TESTING,

ADJUSTING AND BALANCING must be fully completed, including testing and inspection, prior to HVAC commissioning, except as noted otherwise in Section 23 05 93. All contract requirements of Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC must be fully completed, including all testing, prior to HVAC commissioning. The time required to complete all work and testing as prescribed by Sections 01 91 00.00 40, 23 09 23.13 20, and 23 05 93 is included in the allotted calendar days for completion.

1.9 SUSTAINABILITY

Submit 6 copies of the NAVFAC Sustainable & Energy Data Record Card no later than 30 calendar days prior to contract completion.

1.10 OPERATION AND MAINTENANCE MANUALS

Submit 6 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.

1.10.1 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 have 0.3937-inch holes and 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.

1.10.2 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.

1.11 CLEANUP

Provide final cleaning in accordance with ASTM E1971 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. Replace filters of operating equipment and comply with the Indoor Air Quality (IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean

landscaped areas. 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.

1.12 REAL PROPERTY RECORD

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft DD Form 1354 attached to this section, and submit an accounting of all installed property with Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations from the Draft DD Form 1354. Contact the Contracting Officer for any project specific information necessary to complete the DD Form 1354. Refer to UFC 1-300-08 for instruction on completing the DD Form 1354. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site:

<http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf>

Submit the completed Checklist for Form DD1354 of Installed Building Equipment items. Attach this list to the updated DD Form 1354.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 23.33

OPERATION AND MAINTENANCE MANUALS FOR AVIATION FUEL SYSTEMS
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 basic designation only.

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA J4 Handbook (Part IV) Federal Supply Class Assignments
(Numeric and Alphabetic Listing)

1.2 CONTRACTOR RESPONSIBILITY

The Contractor is responsible for providing the technical publications specified herein for all of the components, assemblies, sub-assemblies, attachments, and accessories, required to be supplied in accordance with submittal requirements of each specification section, regardless of whether the item was manufactured and assembled in-house or obtained from other sources. The System Supplier is responsible to the Contractor for providing the technical publications specified herein for all of the components, assemblies, sub-assemblies, attachments, and accessories that the System Supplier provided.

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-10 Operation and Maintenance Data

System Instructions; G

Updated Operations and Maintenance Manual LP-Gas Storage,
Vaporization and Distribution System SWOSU Fire Fighter Trainer
(Building 510); G

PART 2 PRODUCTS

2.1 DEVELOPMENT OF SUBMITTALS

2.1.1 Operation and Maintenance System Instructions (OMSI) Submittal Requirements

OMSI submittals are required in order that complete documentation can be assembled to provide the Government "Activity" with the necessary information and orientation to adequately operate and maintain the new structures/facilities of this project. Submit the OMSI documents and information specified for the equipment listed under the OMSI submittal

paragraphs in each technical section. Five copies of each OMSI submittal shall be forwarded to the Contracting Officer no later than 120-days prior to contract completion. OMSI submittals are to be submitted separate from and in addition to Contractor's product approval submittals.

2.1.2 Assembly

Provide submittals in separate folders consistent with the Contractor's standard practice. Manufacturer's manuals or data for the components, assemblies, subassemblies, and other operating parts which are provided shall be assembled into a loose-leaf notebook-type folder, indexed by major assembly and component in sequential order. Manuals shall be complete in all respects for all equipment, controls, and accessories provided. In addition, provide an electronic copy of the manuals in Adobe Acrobat 8.0 or later (CD-ROM or DVD-ROM). Utilize Bookmarks to display indexing, and assembly and component requirements.

2.2 IDENTIFICATION

On each folder identify and mark as follows:

- a. Inscribe on the cover, the words, "FUEL SYSTEM OPERATION AND MAINTENANCE MANUAL", the name and location of the building, and the contract number.
- b. Equipment manufacturer and/or Contractor's address and telephone number; names, address and telephone numbers of each subcontractor installing equipment; and local representative for each item of equipment.
- c. Volume number and title of the folder.
- d. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. Sub-divide manuals or provide separate manuals for each of the following categories.
 - (1) Operating Instructions
 - (2) Maintenance, Service, and Repair Instructions
 - (3) Parts Manual
 - (4) LP-Gas Storage, Vaporization and Distribution System SWOSU Fire Fighter Trainer (Building 510)

PART 3 EXECUTION

3.1 OPERATING INSTRUCTIONS

The operator's instructions shall include specific instructions and illustrations of the equipment operation required or recommended by the manufacturer as follows:

3.1.1 Safety

Include manufacturer's safety precautions to be observed while operating under all conditions for which the equipment was designed. Clearly list all major hazards to personnel and equipment safety that are peculiar to systems and equipment described in the manual.

3.1.2 Operator Prestart

Include instructions for prestart checks, lubrication, and service

requirements necessary for setting up or preparing each system for use, warm up procedures, and verification of normal operation. Include control diagrams with data to explain detailed operation and control of each item of the equipment.

3.1.3 Starting and Shutdown Procedures and Controls

Include a control sequence describing start up operation and provide shutdown procedures and post-shutdown requirements.

3.1.4 Normal Operating Instructions

Instructions shall be sufficient to enable the mechanic to adjust, stop and start, and operate the equipment properly. Special startup precautions shall be noted, as well as other items requiring action before the equipment may be put into service. Include detailed drawings indicating procedure and valve numbers and status as to normally open/closed.

3.1.5 Emergency Operating Procedures

Include action to be taken in the event of a malfunction of the unit, either to permit a short period of continued operation or to prevent further damage to the unit and to the system in which it is installed.

3.1.6 Operator Service Requirements

Include instructions for operator service requirements during operation of the equipment.

3.2 OPERATION INSTRUCTION TO GOVERNMENT PERSONNEL

Furnish the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. A minimum of 1 man-day (8-hours) of instruction shall be furnished for each system specified in other sections. When more than 4 man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used 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, additional instruction shall be provided to acquaint the operating personnel with the changes or modifications. Government representatives shall be allowed to video tape all classroom and field instructions.

3.3 MAINTENANCE, SERVICE AND REPAIR INSTRUCTIONS

The shop or maintenance manual shall include manufacturer's instructions to maintain the equipment in a safe and serviceable condition. The maintenance or shop manual shall contain all necessary instructions, illustrations, charges and diagrams covering, as a minimum, the items listed below.

3.3.1 Lubrication Instructions

- a. Include a table showing recommended lubricants for specific temperature ranges and applications.
- b. Include chart(s) with schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities. Provide a lubrication schedule showing service interval frequency.

3.3.2 Table of Preventative Maintenance Instructions

Include frequency in time, miles or hours covering routine servicing, lubrication, and adjustments.

3.3.3 Preventative Maintenance Inspection

Points and checklist should be clearly spelled out as part of operator-type inspection in this section. Include chart with schematic diagram and/or a separate inspection checklist indicating what should be examined for wear or possible malfunction and what should be reported for repair.

3.3.4 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to enable prompt isolation of the cause of a malfunction with corrective maintenance instructions. Instructions shall clearly indicate why the check out is performed and what conditions are to be sought.

3.3.5 Removal and Replacement Instructions

Provide step-by-step procedures for removal, replacement, disassembly and assembly of all components, assemblies, sub-assemblies, accessories, and attachments normally subjected to wear, damage, malfunction, and frequent replacement. These instructions should provide for a judicious combination of text and illustrations.

3.3.6 Maintenance and Repair Procedure

Provide instructions for tolerances, dimensions, settings, and adjustments normally required for performing routine maintenance servicing. Instructions shall provide the necessary information to bring equipment up to the required serviceable standard when it becomes unserviceable. Include instructions for examining equipment for needed repairs and adjustment, and any tests or inspections required to determine whether or not parts must be replaced.

3.4 PARTS MANUAL

3.4.1 Contents

The parts manual shall provide positive identification and coverage for all of the parts of components, assemblies, sub-assemblies, and accessories of the end item normally subject to wear, malfunctioning, damage, or loss. Include any special hardware requirements (eg., high-strength bolts and nuts). The parts manual may cover more than one model or series or equipments, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice. Identification of the parts

shall be such that all parts may be ordered and centrally stocked by the government without further identification to the make, model, and serial number of the equipment being provided.

3.4.2 Illustrations, Drawings, and/or Exploded Views

Provide clear and legible illustrations, drawings, and/or views to enable easy identification of all individual parts, components, assemblies, sub-assemblies, and accessories of the end item. Show part numbers and description on illustrations or list separately. When the illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to listed part. Parts shown in the listings shall be grouped by components, assemblies, and sub-assemblies with individual parts identified to the assembly.

3.4.3 End Item Manufacturer's Part Numbers

Include parts for which the end item manufacturer has proprietary rights or has exercised design control, and for which the end item manufacturer is the logical supplier. The end item manufacturer shall also assign numbers to purchased production parts, if such parts are altered to meet the prime manufacturer's design configuration. (Repainting, marking, or other insignificant operations are not adequate cause for use of exclusively assigned numbers).

3.4.4 Components Assemblies/Parts

Include those components assemblies/parts purchased by the end item manufacturer for which the end item manufacturer does not have control, and shall be identified by the actual manufacturer's name and part numbers. Detail parts in the manufacturer's assembly, as well as attaching parts, for which the manufacturer does not have design control shall also be identified by the applicable actual manufacturer's parts numbers. This paragraph does not restrict the end item manufacturer from assigning part numbers as long as the actual manufacturer's part number and the Federal Supply Code for Manufacturer (DLA J4 Handbook) or manufacturer is shown.

3.4.5 Appendices

End item manufacturer may add an appendix for cross-reference to implement components assemblies/parts requirements when implementation in manual form varies drastically with the style, format, and method of Contractor's standard commercial practice. Subject cross-referenced in an appendix will appear in the following format:

End Item Manufacturer's Alpha Numeric Seq.	Actual Manufacturer's Name and/or FCSM* from DLA J4 Handbook	Actual Manufacturer Part No.
100001	John Doe & Co. 000000	2000002
*Federal Supply Code for Manufacturers Cataloging Handbook, Name to Code		

3.5 LP-GAS STORAGE, VAPORIZATION AND DISTRIBUTION SYSTEM SWOSU FIRE FIGHTER TRAINER (BUILDING 510)

Update and include the final Updated Operations and Maintenance Manual LP-Gas Storage, Vaporization and Distribution System SWOSU Fire Fighter Trainer (Building 510) as part of the O&M manuals. This manual will be provided by the Government at the Pre-Construction meeting. Updates will include attaching Operating Instructions: Maintenance, Service, and Repair Instructions; and Parts Manuals, as well as other O&M data for the propane equipment and system.

3.6 VALIDATION

Each submittal shall be validated by the Contractor or Manufacturer as being accurate and applicable to the systems and equipment provided.

3.7 SPECIFIC EQUIPMENT SUBMITTALS

The technical sections of this specification identify the specific equipment or systems for which OMSI submittals are required. This paragraph and its subparagraph contain a general list of various types of equipment and systems together with the OMSI information required for each type. The applicable OMSI information contained in this paragraph shall be submitted for each specific piece of equipment or system listed under the "OMSI Submittals" paragraph in the technical sections. Operating instructions; maintenance, service, and repair instructions; and parts manuals shall conform to the requirements of their respective paragraph herein. Provide validation in accordance with paragraph VALIDATION for all submittals.

3.7.1 Pressure Gages

- a. Manufacturer's descriptive literature, general.
- b. Parts manuals and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).

3.7.2 Automatic Pump Controls

Includes Pressure Indicating Transmitters, Flow Switches, Venturi Tubes, Differential Pressure Transmitters.

- a. Manufacturer's descriptive literature, general.
- b. Parts manual.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.

- g. Control wiring diagrams showing all terminations of conductors (and all control devices) labeled to permit identification in the field; part numbers of all control devices; normally open or normally closed; voltage of all control components.
- h. Name, address and telephone number of the nearest manufacturer's representative.

3.7.3 Meters

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service, calibration instructions, and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.
- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.4 Oil/Water separator and Accessories

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.
- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.5 Product Recovery Tank and Accessories

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.

- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.6 Truck Offload System

- a. General description and specifications.
- b. Comprehensive discussion of operating program.
- c. Installation and initial checkout procedures.
- d. Detailed electrical description.
- e. Complete troubleshooting procedures, diagrams, and guidelines.
- f. Complete alignment and calibration procedures for components.
- g. Preventive maintenance requirements.
- h. Detailed system schematics, system field assembly drawings, and system component specifications and dimensions.
- i. Complete spare parts lists.
- j. Complete as-built bill of materials, control drawings, schedules, and sequence of operations.
- k. Safety precautions.
- l. Control sequence describing start-up, operation, and shutdown. Control sequence shall be integrated with startup and operation of the motor control center.
- m. Part list which shall indicate sources of supply, recommended spare parts, and name of servicing organization.
- n. Manufacturer's name, address, and telephone number.

3.7.7 Hydrant Outlet Pits, Isolation Valve Pits, High Point Vent and Low Point Drain Pits

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- e. Name, address and telephone number of the nearest manufacturer's representative.

3.7.8 Operating Tank Level Indicator

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.

- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.
- g. Control wiring diagrams showing all terminations of conductors (and all control devices) labeled to permit identification in the field; part numbers of all control devices; normalcy open or normally closed; voltage of all control components.
- h. Name, address and telephone number of the nearest manufacturer's representative.

3.7.9 Pantographs

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.
- g. Name, address and telephone number of the nearest manufacturer's representative.
- h. SSEA approval letter.

3.7.10 Piping and Fittings

- a. Certificates of Compliance.
- b. Batch run numbers.
- c. Manufacturer's descriptive literature, general.
- d. Name address and telephone number of manufacturer.

3.7.11 Manual Valves

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).

- f. Performance data at specified conditions.
- g. Where specified to have limit switches, control wiring diagrams showing all terminations of conductors (and all control devices) labeled to permit identification in the field; part numbers of all control devices; normally open or normally closed; voltage of all control components.
- h. Name, address and telephone number of the nearest manufacturer's representative.

3.7.12 Flexible Ball Joints

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- e. Name, address and telephone number of the nearest manufacturer's representative.

3.7.13 Gaskets and Isolating Gasket Kits

- a. Manufacturer's descriptive literature, general.
- b. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- c. Name, address and telephone number of the nearest manufacturer's representative.

3.7.14 Strainers

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- e. Name, address and telephone number of the nearest manufacturer's representative.

3.7.15 Protective Coatings

- a. Manufacturer's descriptive literature, general.
- b. Maintenance, service and repair instructions.
- c. Manufacturer's name, model number, serial number, Federal Stock Number (if any).

- d. Name, address and telephone number of the nearest manufacturer's representative.
- e. Product standards compliance and the materials system data sheet.

3.7.16 Sample Connections

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Name, address and telephone number of the nearest manufacturer's representative.

3.7.17 Filter Separators

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- f. Performance data at specified conditions.
- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.18 Water Draw-Off System

- a. Manufacturer's descriptive literature, general.
- b. Maintenance, service and repair instructions.
- c. Operating Instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- e. Name, address and telephone number of the nearest manufacturer's representative.

3.7.19 Pumps - Fueling, Offload, Fuel Transfer, Bowser Pumpoff Pump, Product Return

- a. Manufacturer's descriptive literature, general.
- b. Parts manual and recommended spare parts list.

- c. Maintenance, service and repair instructions.
- d. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- e. Performance data at specified flow rates. Performance shall include:
 - (1) Head developed, horsepower required and efficiency.
 - (2) Pump curves, flow and power requirements, efficiency, head and operating speed. Curves to show operating points at full range of operating conditions.
- f. Control wiring diagrams showing all terminations of conductors (and all control devices) labeled to permit identification in the field; part numbers of all control devices; normally open or normally closed; voltage of all control components and operational description.
- g. Plan and elevation views of equipment showing clearance required for maintenance and/or replacement.
- h. Name, address and telephone number of the nearest manufacturer's representative.
- i. Shipping and operating weights.
- j. Operating instructions.
- k. Factory run test curves indicating flow, head rpm, vibration amplitude and BHP.

3.7.20 Flexible Hoses

- a. Manufacturer's descriptive literature, general.
- b. Maintenance service and repair instructions.
- c. Manufacturer's name, model number, serial number.
- d. Name, address and telephone number of the nearest manufacturer's representative.

3.7.21 Control Valves

Submit for each type control valve specified

- a. Manufacturer's descriptive literature, general.
- b. Operational description of valve and control pilots.
- c. Description of valve assembly complete with parts list.
- d. Recommended spare parts list for main valve and pilot control systems.
- e. Instructions for trouble shooting.
- f. Maintenance, service and repair instructions.

- g. Manufacturer's name, model number and stock number.
- h. Operational Test Data.

3.7.22 Engine-Generator

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
- b. A control sequence describing startup, operation, and shutdown.
- c. Description of the function of each principal item of equipment.
- d. Installation and maintenance instructions.
- e. Safety precautions.
- f. Diagrams and illustrations.
- g. Testing methods.
- h. Performance data.
- i. Lubrication schedule including type, grade, temperature range, and frequency.
- j. Parts list: The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
- k. List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

3.7.23 Fire Alarm and Fire Detecting System

- a. Manufacturer's descriptive literature, general.
- b. Parts manual.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Drawing of component arrangement, schedule of components with sizes, types, and ratings, and wiring diagrams.
- f. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.24 Motor Control Center

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
- b. A control sequence describing startup, operation, and shutdown.
- c. Description of the function of each principal item of equipment.

- d. Installation and maintenance instructions.
- e. Safety precautions.
- f. Diagrams and illustrations.
- g. Parts list.
- h. Drawing of component arrangement, schedule of components with sizes, types, and ratings.
- i. Manufacturer's name, model number, serial number.
- j. Name, address and telephone number of the nearest manufacturer's representative.

3.7.25 Non-Automatic Transfer Switch

- a. Manufacturer's descriptive literature, general.
- b. Parts list.
- c. Maintenance, service and repair instructions.
- d. Operating Instructions.
- e. Drawing of component arrangement, schedule of components with sizes, types, and ratings, and wiring diagrams.
- f. Manufacturer's name, model number, serial number, Federal Stock Number (if any).
- g. Name, address and telephone number of the nearest manufacturer's representative.

3.7.26 Pump Control Panel (PCP)

- a. General description and specifications.
- b. Comprehensive discussion of both hardware and operating program.
- c. Installation and initial checkout procedures.
- d. Detailed electrical and logical description.
- e. Complete troubleshooting procedures, diagrams, and guidelines.
- f. Complete alignment and calibration procedures for components.
- g. Preventive maintenance requirements.
- h. Detailed system schematics, system field assembly drawings, and system component specifications and dimensions.
- i. Complete spare parts lists.
- j. Interface requirements and capabilities.

- k. Signal identification and timing diagrams.
- l. Complete as-built bill of materials, control drawings, schedules, and sequence of operations.
- m. Safety precautions.
- n. Control sequence describing start-up, operation, and shutdown. Control sequence shall be integrated with startup and operation of the motor control center.
- o. Part list which shall indicate sources of supply, recommended spare parts, and name of servicing organization.
- p. Manufacturer's name, address, and telephone number.
- q. Supplier name, manufacturer and version of all software including: PLC, desktop computer, laptop computer, and "alternate" desktop computer.

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

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.

ASTM INTERNATIONAL (ASTM)

ASTM E1971 (2005; R 2011) Stewardship for the
Cleaning of Commercial and Institutional
Buildings

1.2 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 preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must 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.

1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 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 must use Data Package 5. Commissioned items with a Data Package 1 or 2 requirement must use instead Data Package 5.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Government's Commissioning Authority (CA) must review the commissioned systems and equipment submittals for completeness and applicability. The CA must 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 must communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA must recommend approval and acceptance of these O&M manuals to the Contracting Officer. This work is in addition to the normal review procedures for O&M data.

1.2.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for all operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 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.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 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.

1.3.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.3.2 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.

1.3.2.1 Lubrication Data

Include preventative 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.

1.3.2.2 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.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features

of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.3.1 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.

1.3.3.2 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.

1.3.3.3 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.

1.3.3.4 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.

1.3.3.5 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.

1.3.4 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.

1.3.5 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:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 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

1.3.5.5 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.

1.3.5.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference all specific operation and maintenance procedures that must be performed to keep the warranty valid.

1.3.5.7 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.

1.3.5.8 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.

1.3.5.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.5.10 Field Test Reports

Provide Field Test Reports (SD-06) that apply to equipment associated with the system.

1.3.5.11 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.

1.4 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 Cx 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 sequence of operations.
- g. Electronic File:
 - (1) Assemble each manual into a composite electronically indexed file in PDF format. Provide HDD's, DVD's or CD's as appropriate, so that each one contains all maintenance and record files, and also the Project Record Documents and Training Videos, of the entire program for this facility.
 - (2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - (3) Link the index to separate files within the composite of files. Book mark maintenance and record files, that have a Table of Contents, according to the Table of Contents
- h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5 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:

1.5.1 Data Package 1

- a. Safety precautions
- b. Cleaning recommendations
- c. Maintenance and repair procedures
- d. Warranty information
- e. Contractor information
- f. Spare parts and supply list

1.5.2 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

1.5.3 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

1.5.4 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
- 1.5.5 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. Manufacturer's instructions
- n. O&M submittal data
- o. Parts identification
- p. Testing equipment and special tool information
- q. Warranty information
- r. Testing and performance data
- s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 24.00 20

FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
02/15

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. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N

(2014) Navy and Marine Corps Design
Procedures

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 eOMSI Manual

Manual (PDF file) provided by the Contractor that includes, but is not limited to, product information, a facility description with photos, and a list of primary facility systems.

1.2.2 eOMSI Facility Data Workbook (FDW)

A Microsoft Excel spreadsheet containing 17 facility asset fields to be populated with the required information by the Contractor.

1.2.3 Systems

The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.2.4 Computer Assisted Design and Drafting (CADD)

Electronic Computer Assisted Design and Drafting graphic software program that is used to create facility design contract documents and Record Drawings.

1.2.5 KTR

An abbreviation for "Contractor."

1.3 EOMSI MEETINGS

1.3.1 Pre-Construction Meeting

Be prepared to discuss the following during this meeting:

- a. eOMSI Manual and eOMSI Facility Data Workbook Development Meetings
- b. Processes and methods of gathering eOMSI Manual and eOMSI Facility Data Workbook information during construction.
- c. The eOMSI Submittals schedule. Include the eOMSI submittal schedule on

the Baseline Construction Schedule in accordance with Section
01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULE (NAS).

1.3.2 eOMSI Manual and Facility Data Workbook Coordination and Mutual Understanding Meeting

Facilitate a meeting after the Pre-Construction Meeting prior to the submission of the eOMSI Progress Submittal. Meeting attendance must include the Contractor's eOMSI Manual and Facility Data Workbook Preparer, Designer of Record (DOR), and Quality Control Manager, the Commissioning Authority (CA), and the Government's Design Manager (DM), Contracting Officer's Representative, and NAVFAC Public Works (PW) Facilities Management Division (FMD). Also include the Mechanical, Electrical, and Fire Protection Sub-Contractors as required.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for eOMSI and coordinate the efforts necessary by both the Government and Contractor to ensure an accurate collection, preparation and timely Government review of eOMSI.

1.3.3 Facility Turnover Meeting

Include eOMSI in Red Zone (NRZ) facility turnover meetings as specified in Section 01 30 00, ADMINISTRATIVE REQUIREMENTS.

1.4 SUBMITTAL SCHEDULING

1.4.1 eOMSI, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the Contracting Officer for approval. Provide eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). Include all elements and portions of system construction completed up to this point.

The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the eOMSI Coordination and Mutual Understanding Meeting. Field verify a portion of the eOMSI information in accordance with paragraph FIELD VERIFICATION.

1.4.2 eOMSI, Prefinal Submittal

Submit the 100 percent submittal of the eOMSI Prefinal Submittal to the Contracting Officer for approval within 60 calendar days of the Beneficial Occupancy Date (BOD). This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the Government's review of eOMSI Progress submittal must be corrected prior to the Prefinal submission.

The eOMSI Prefinal Submittal must include eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel).

1.4.3 eOMSI, Final Submittal

Submit completed eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). The Final submittal is due at BOD. Any discrepancies discovered during the Government's review of the Prefinal eOMSI submittal, including the Field Verification, must be corrected prior

to the Final eOMSI submission.

1.5 UNITS OF MEASURE

Provide eOMSI utilizing the units of measure used in the Government generated contract documents.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and in coordination with the requirements of Section 01 78 00 CLOSEOUT SUBMITTALS.

SD-10 Operation and Maintenance Data

Training Plan; G, A/E

Training Outline; G, A/E

Training Content; G, A/E

SD-11 Closeout Submittals

eOMSI, Progress Submittal; G, A/E

eOMSI, Prefinal Submittal; G, A/E

eOMSI, Final Submittal; G, A/E

Training Video Recording; G, A/E

Validation of Training Completion; G, A/E

PART 2 PRODUCTS

2.1 eOMSI FILES FORMAT

Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains all maintenance and record files, and Project Record Documents and Training Videos. Include a complete electronically linked operation and maintenance directory. Provide four electronic copies of the eOMSI Manuals to the Contracting Officer for approval.

Provide eOMSI Facility Data Workbook on compact disks (CD) or data digital versatile disk (DVD) disks in (EXCEL) format. Scan eOMSI Manual Files and eOMSI Facility Data Workbook for malicious viruses using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

2.1.1 eOMSI Manual Organization

Organize the eOMSI Manuals into two parts: 1) Product and Drawing Information, and 2) Facility Information. Bookmark the PDF files for easy

access to the information.

- a. Bookmark Facility Information and Primary Systems to at least one level lower than the major system.
- b. Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

2.1.2 eOMSI Manual Compact Disk Label and Disk Holder or Case

Provide the following information on the compact disk label and disk holder or case:

- a. Building Number
- b. Project Title
- c. Activity and Location
- d. Construction Contract Number
- e. Prepared For: (Contracting Agency)
- f. Prepared By: (Name, title, phone number and email address)
- g. Include the compact disk content on the disk label
- h. Date
- i. Virus scanning program used

2.2 EOMSI MANUAL

2.2.1 Product and Drawing Information

Provide an organized record of the facility products, materials, equipment, and minimum information necessary to operate the facility. Provide Product and Drawing Information for all systems in the final constructed facility. Organize and bookmark the information for easy access and quick retrieval.

2.2.1.1 O&M Data

As a minimum, include the O&M Data, submitted in the technical specification sections, and in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.2.1.2 Record Drawings

Provide an electronic, PDF copy of the Record Drawings, prepared in accordance with FC 1-300-09N and Section 01 78 00 CLOSEOUT SUBMITTALS. Bookmark all drawings using the sheet title and sheet number.

Include Record Drawings as part of the Red-Zone in accordance with Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

2.2.1.3 Utility Record Drawings

Using Record Source Drawings, show and document details of the actual installation of the utility systems; annotate and highlight the eOMSI information. Provide Utility Record Drawings in PDF format. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

- a. Utility Schematic Diagrams - Provide a one line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the 5 foot connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.
- b. Enlarged Connection and Cutoff Plans - Provide enlarged floor plans that provide information between the 5 foot utility connection point and where utilities connect to facility distribution. Enlarge floor plans / elevations of the rooms where the utility enters the building and indicate on these plans locations of the main interior and exterior connection and cutoff points for all utilities. Also enlarge floor plans / elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number, of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

2.2.2 Facility Information

Provide the following in Facility Information:

2.2.2.1 General Facility and System Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems listed in the Primary Systems Information and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

2.2.2.2 Basis of Design

Include the Basis of Design that shows the basic design scope of work, assumptions and the original intentions of the Designer of Record (DOR). Identify the site utility design goals, objectives, design load limits, assumptions, and system features that are critical to the operation and maintenance of the systems.

2.2.2.3 Floor Plans

Provide uncluttered, legible 11 by 17 inches floor plans. Include room numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

2.2.2.4 Floor Coverings, Wall Surfaces, and Ceiling Surfaces

Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish, manufacturer's product name, identifying number, and color. Include a facility summary of the total area for each type of space and floor, wall, or ceiling finish in the table.

2.2.2.5 Roofing

Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers; manufacturer's product name, identifying number, and color. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.2.2.6 HVAC Filters

Provide a table that lists the quantity, type, size, and location of each HVAC filter, manufacturer's product name, and identifying number.

2.2.2.7 Plumbing Fixtures

Provide a table that lists by room number, the number and type of plumbing and bathroom plumbing fixtures (for example, sinks, water closets, urinals, showers and drinking fountains).

2.2.2.8 Lighting Fixtures

Provide a table that lists by room number (including hallways and common spaces), the type of lighting fixture, ballast, number of lighting fixtures, type of lamps and number of lamps, and the manufacturer's product name and the identifying number. The table must include a facility summary of the total number of fixtures of each type and number of lamps of each type.

2.2.2.9 Equipment Listing

Provide a table that lists the major equipment shown on the design equipment schedules. Show the item descriptions, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers, contractors, and subcontractors.

2.2.2.10 System Flow Diagrams

Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate all system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system components are not acceptable.

2.2.2.11 Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

2.2.2.12 Riser Diagrams

Provide riser diagrams and settings of equipment.

2.3 eOMSI FACILITY DATA WORKBOOK

Download the eOMSI Facility Data Workbook at the following location:
<http://www.wbdg.org/ccb/NAVGRAPH/graphdoc.pdf>. Complete the KTR Facility Data File tab based on the selection of master systems, systems, and subsystems installed. The following tabs are included in the eOMSI Facility Data File Workbook and serve the purpose stated:

- a. Instructions Tab: Instructions for completing Model & Facility Data Matrix Tab and KTR Facility Data File. If a discrepancy exists between what is required in this section and the Workbook, the instructions within the workbook take precedence.
- b. Model & Facility Data Matrix Tab: The Matrix lists Required Asset Fields for each SYSTEM and SUBSYSTEM. The Designer of Record selects SYSTEMS and SUBSYSTEMS that are within the project scope, which the Contractor needs to include and populate in KTR Facility Data File tab. The "Required Facility Asset Field Position Numbers," one through seventeen, are pre-populated, and are not editable.
- c. Required Asset Fields Tab: Defines the 17 Required Facility Asset Field Position Numbers used in Model and Facility Data Matrix and KTR Facility Data File tabs.
- d. KTR Sample Facility Data File Tab: Sample KTR eOMSI facility data file. This spreadsheet shows an example of the mandatory fields of all equipment to be included in the KTR eOMSI Facility Data File, along with their descriptions.
- e. KTR Facility Data File Tab: Required eOMSI facility data file deliverable provided to the Government. Provide a separated and unique new row for each facility component or piece of equipment installed. Asset number will be provided at final by the Government.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

Field verify eOMSI Facility Data Workbook information with Contractor and Government personnel. Include the following personnel in this meeting: Contractor's eOMSI Manual and Facility Data Workbook Preparer and Quality Control Manager, Commissioning Authority, and the Government's Contracting Officer's Representative and NAVFAC PW FMD. Request, and provide, an eOMSI Field Verification Meeting no sooner than 14 calendar days after submission of the Progress eOMSI submittal, and another, no sooner than 14 calendar days after submission of the Prefinal eOMSI submittal. During this meeting, the Government and Contractor will verify that the eOMSI Facility Data Workbook is complete and accurate.

Field verify that at least 5 Subsystems under each of the Master Systems are accurate, for a total of 25 Subsystems. For each of these items, verify that the required facility asset field, as defined in the "Model & Facility Data Matrix" tab, contains the specified data and it is accurate (i.e. item description, manufacturer, model no., serial no.). 100 percent accuracy of eOMSI information is required for successful field

verification. Any discrepancies discovered must be corrected prior to next eOMSI Facility Data Workbook Submittal.

- (1) D20 - PLUMBING
- (2) D30 - HVAC
- (3) D40 - FIRE PROTECTION
- (4) D50 - ELECTRICAL

3.2 eOMSI TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The trainees must include the Facilities Management Specialist, building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address all aspects of the eOMSI Manual and Facility Data Workbook submittal. Training must include classroom and field lectures as applicable. The location of classroom training requires approval by the Contracting Officer.

3.2.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Indicate prior approval of the training plan by the Quality Control Manager (QC) Commissioning Authority (CA) on the submittal forwarded to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

- a. Equipment included in training
- b. Intended audience
- c. Location of training
- d. Dates of training
- e. Objectives
- f. Outline of the information to be presented and subjects covered including description
- g. Start and finish times and duration of training on each subject
- h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)
- i. Instructor names and instructor qualifications for each subject
- j. List of texts and other materials required to support training

3.2.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information defined in Section 01 78 23 OPERATIONS AND MAINTENANCE DATA. The CA is responsible for overseeing and approving the content and adequacy of the training. Provide a brief summary of "Facility Information" and a more detailed presentation of, "Primary Systems Information". Spend 95 percent of the instruction time

during the presentation on the "Primary Systems Information". Include the following for each Primary system training presentation:

- a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.
- b. Relevant health and safety issues.
- c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.
- d. Design intent.
- e. Use of O&M Manual Files.
- f. Review of control drawings and schematics.
- g. Interactions with other systems.
- h. Special maintenance and replacement sources.
- i. Tenant interaction issues.

3.2.3 Training Outline

Provide the eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.2.4 Training Video Recording

Provide to the Contracting Officer two copies of the training course in DVD video recording format. Capture within the recording, in video and audio, all instructors' training presentations including question and answer periods with the trainees. Confirm proposed software used to create the training is compatible with the using activity resources to play the training materials. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.2.5 Unresolved Questions from Trainees

If, at the end of the training course, there are questions from trainees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the trainees, and the training video must be modified to include the appropriate clarifications.

3.2.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of all training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of

the validation to the Contracting Officer, and one copy to the eOMSI
Preparer for inclusion into the eOMSI documentation.

3.2.7 Quality Control Coordination

Coordinate the eOMSI training with the QC CA in Section 01 45 00.00 20
QUALITY CONTROL

-- End of Section --

01 91 00.00 40

COMMISSIONING
11/12

PART 1 GENERAL

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

This Section includes:

a. Commissioning of the following systems:

- (1) HVAC systems: Heating and Ventilating Units, High Temperature Exhaust Fan Systems, Cooling/Dehumidification Units, including all associated motor starters, motor controllers and variable frequency drives
- (2) Building Automation System (BAS): control hardware and software, sequence of operations, and integration of factory controls with BAS
- (3) Building Automation System (BAS): Integration with trainer controls by others
- (4) Propane distribution system up to burner control cabinets, including vaporizers, remote fill station controls, system monitoring controls, and emergency shutoff controls and switches.
- (5) Process water and drain systems, including pumps and level controls
- (6) Lighting controls serving trainer spaces
- (7) Fire Alarm System
- (8) Door operation - including proper latching and closure

The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

The following Sections are an integral part of this project Commissioning:

- a. Section 01 30 00 ADMINISTRATIVE REQUIREMENTS
- b. Section 01 45 00.00 20 QUALITY CONTROL
- c. Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS
- d. 01 78 00 CLOSEOUT SUBMITTALS
- e. Section 01 78 23 OPERATION AND MAINTENANCE DATA
- f. 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
- g. Section 22 00 00 PLUMBING, GENERAL PURPOSE

- h. Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
 - i. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS
 - j. Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS
 - l. Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
- 1.1 DEFINITIONS
- a. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Project Requirements. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the Project Requirements may be included.
 - b. Commissioning - Commissioning is a comprehensive and systematic process to verify that the systems to be commissioned perform as designed to meet the requirements. Commissioning during the construction, acceptance, and warranty phases intends to achieve the following specific objectives:
 - (1) Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
 - (2) Verify equipment and systems are properly integrated and coordinated.
 - (3) Verify and document that equipment and systems receive complete operational checkout by the installing contractors.
 - (4) Verify and document equipment and system performance.
 - (5) Verify the completeness of Operations and Maintenance materials.
 - (6) Ensure that the operating personnel are adequately trained on the operation and maintenance of the building equipment.
 - c. Commissioning Agent - develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after pre-functional checklists and startup are complete.
 - d. Commissioning Plan - an overall plan that provides the structure, schedule and coordination planning for the commissioning process.
 - e. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents, does not perform properly, or is not complying with the Project Requirements.
 - f. Project Requirements - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very

important to the Government. It is initially the outcome of the programming and conceptual design phases.

- g. Functional Performance Test - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word.
- h. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- i. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- j. Pre-functional Checklist - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the Commissioning Agent to the contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word "pre-functional" refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist.
- k. Seasonal Performance Tests - Functional Performance Test that are deferred until the system(s) will experience conditions closer to their design conditions.
- l. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.2 ADMINISTRATIVE REQUIREMENTS

Perform commissioning services for the system. Expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The commissioning requires cooperation of the Contractor, subcontractors, vendors, Architect/Engineer, Commissioning Agent, and Contracting Officer.

1.2.1 Co-ordination

The Owner hired Commissioning Agent will provide overall co-ordination and management of the commissioning program. The commissioning team comprises

the following groups:

- a. Contractors Project Manager and Test Engineer
- b. Sub-contractor for the system being commissioned
- c. Commissioning Agents Project Manager and Project Engineers
- d. Contracting Officers Representative
- e. Architect/Engineer and Specialty Consultant

Note that this project will require two distinct phases of Commissioning, in conjunction with a separate Contractor. Initial Functional Performance Testing will occur on the HVAC (HVUs and HTEFs systems) to ensure proper operation for completion of trainer control system start up. Integrated Functional Testing with the trainer control system will be performed upon completion of that system by others. The integrated functional testing will be a coordinated effort between this project and the trainer controls contractor.

1.2.2 Progress Meetings

Plan and co-ordinate meetings as required to monitor construction and commissioning progress the work. Notify the Contracting Officer and Commissioning Agent of construction job-site meetings to address co-ordination, deficiency resolution and planning issues.

1.2.3 Functional Testing Co-ordination

Do **not** "temporarily" start equipment for commissioning. Do not conduct functional performance testing until a pre-functional, start-up and TAB is completed for a given system. Do not functionally test the controls system and equipment it controls until all points have been calibrated and the pre-functional checklists are completed.

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 and in coordination with 01 78 00 CLOSEOUT SUBMITTALS and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI).

SD-01 Preconstruction Submittals

Start up and Contractor Test Plan; G, A/E

Start up and Contractor Test Schedule; G, A/E

Commissioning Schedule with Commissioning Activities; G, A/E

SD-06 Test Reports

Functional Performance Testing Results; G

Seasonal Testing Report; G

Deficiency Report and Resolution Record; G

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals; G, A/E

Training Plan; G, A/E

Operations and Maintenance Database; G, A/E

SD-11 Closeout Submittals

Warranty; G, A/E

1.4 QUALITY CONTROL

Inspection and testing Qualifications: Engage inspection and testing service personnel that specialize in the types of inspections and tests to be performed.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

Ensure instrumentation used for testing meets the following standards:

- a. Sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
- b. Calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
- c. Maintained in good repair and operating condition throughout the duration of use on this project.

Contractor to provide all standard testing equipment required for performing startup and initial checkout and required functional performance testing for the system. Data logging equipment or software required to test equipment will be provided by the Commissioning Agent, and not become the property of the Government.

2.1.1 Testing and Start-Up Plan

Develop a Testing and Start-up Plan to identify how Contractors Testing and Start-up activities will be integrated into general construction and trade activities.

The Plan identifies who is responsible for producing the various procedures, reports, forms, and notifications.

The Plan shall delineate the two distinct testing phases on the project.

2.2 START-UP/PRE-FUNCTIONAL CHECKLISTS

Coordinate start-up plans and documentation formats with pre-functional checklists to be completed during the startup process. Manufacturer's start-up checklists and other technical documentation guidelines can

supplement pre-functional checklists.

2.3 PERFORMANCE VERIFICATION TESTING

Contractor shall perform Performance Verification Testing (PVT) where specified. PVTs shall be completed after Pre-functional checklists and TAB are completed and accepted. PVTs shall be performed prior to Functional Performance Testing.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS

The Commissioning Agent coordinates all activities. The following activities outline the commissioning tasks and the general order in which they occur.

a. Commissioning Kick-Off Meeting

Equipment and Component Submittal Reviews

c. Contractor QC/QA test Submittal Reviews

d. Start-Up/Pre-Functional Checklists

e. Performance Verification Testing

f. Functional Performance Testing

f. Short-Term Diagnostic Testing

g. Deficiency Report and Resolution

h. Operations and Maintenance Training

i. Record Documents Review

k. Final Commissioning Report Documentation

j. Deferred testing due to unforeseen deferred tests, seasonal testing or end of Warranty review.

3.2 START-UP/PREFUNCTIONAL CHECKLISTS

3.2.1 Equipment Start-up

Contractor shall provide a start up plan and schedule. Contractor shall provide and complete start up reports on each piece of new, replacement or refurbished equipment. Reports shall include:

Point to Point checkout

Calibration Report

Function checkout report for all devices, actuators and controlled components.

3.2.2 Controls Start-up:

Contractor shall provide a start up plan and schedule. Contractor shall provide and complete start up reports on each piece of new, replacement or

refurbished equipment.

3.2.3 Prefunctional Checklists

Contractor shall complete prefunctional checklists provided by the Commissioning Agent. Completed Prefunctional checklist will be required prior to functional performance testing.

3.2.4 Performance Verification Testing

Contractor shall perform Performance Verification Testing where specified upon completion of TAB and Prefunctional Checklists prior to Functional Performance Testing.

3.3 FUNCTIONAL PERFORMANCE TESTING

Assist the Commissioning Agent in functional performance testing. Contractor shall operate and facilitate testing, orchestrated and recorded by the Commissioning Agent. Initial Functional Performance Testing will occur on the HVAC (HVUs and HTEFs systems) to ensure proper operation for completion of trainer control system start up. Integrated Functional Testing with the trainer control system will be performed upon completion of that system by others. The integrated functional testing will be a coordinated effort between this project and the trainer controls contractor.

3.3.1 Functional Performance Test Procedures

The Commissioning Agent will develop functional performance test procedures for equipment and systems. Identifying specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Contractor shall review and coordinate test procedures with the installing contractor for feasibility, safety, equipment and warranty protection.

3.3.2 Test Methods

Methods for functional performance testing and verification include direct manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with the building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using the building automation system, or short-term monitoring of system inputs and outputs using stand alone data loggers. The Commissioning Agent determines which method, or combination of methods, is most appropriate.

3.3.3 Setup

Perform each test procedure under conditions that simulate operating conditions required by the test. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, functional performance test procedures shall demonstrate the actual performance of safety shutoffs in a real or closely-simulated conditions of failure.

3.3.4 Sampling

The Commissioning Agent develops a sampling strategy when multiple identical pieces of non-life-safety or non-critical equipment may be

functionally tested. Sample testing will be conducted based on a graduated sampling rate based on failures, with the sample rate increasing by a factor of 2 for 3 times. If, after three test attempts at testing the specified sample percentage, failures are still present, then test all remaining units at the Contractors' expense. (e.g. 10 percent, one failure, sampling increases to 20 percent. Another failure and the sampling increases to 40 percent. Additional failure and the all units are tested at 100 percent.)

3.3.5 Functional Performance Testing Results

Coordinate and assist in retesting as necessary until satisfactory performance is verified.

3.4 SHORT-TERM DIAGNOSTIC TESTING

After initial occupancy, short-term diagnostic trending, using data loggers and/or building automation trending capabilities will be performed to record system operation over a two week period.

Upon trend review by the Commissioning Agent, the Contractor(s) shall make any required adjustments to assure equipment and systems are operating correctly.

3.5 DEFICIENCY REPORT AND RESOLUTION RECORD

Items of non-compliance in materials, installation or operation recorded during the construction and commissioning will be recorded by the Commissioning Agent. Contractor(s) are required to correct these items.

3.5.1 Non-Conformance

The Contractor(s) shall correct non-conformance and deficiencies.

Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Agent. In such cases the Commissioning Agent will document the deficiency and resolution on the procedure form and/or in the commissioning issues report log.

3.5.1.1 Identified Deficiencies Correction Procedure

If there is no dispute on the deficiency and the responsibility to correct it:

- a. The Commissioning Agent documents the deficiency and the adjustments or alterations required to correct it. The Contractor corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested.
- b. The Commissioning Agent reschedules the test and the test is repeated.

If there is a dispute about a deficiency or who is responsible:

- a. The deficiency is documented on the non-compliance form and a copy given to the Contracting Officer's Representative.
- b. Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor has responsibility for resolving construction deficiencies.

If a design revision is deemed necessary and approved by the Contracting Officer, the Architect/Engineer has responsibility for providing a design revision.

- c. The Commissioning Agent documents the resolution process in the commissioning issues report log.
- d. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested. The Commissioning Agent reschedules the test and the test is repeated until satisfactory performance is achieved.

The Contractor is responsible for retesting costs.

3.6 OPERATIONS AND MAINTENANCE TRAINING

Provide complete Operations and Maintenance Manuals.

Develop and submit a Training Plan, identifying equipment and systems training will be provided, what training materials will be used, training schedule, and how training will be performed.

Coordinate and review with the Commissioning Agent and Contracting Officers' Representative the training program(s) for O&M personnel.

Develop the database from the O&M manual containing the information required to start a preventative maintenance program. Reference Section 01 78 23 for requirements.

Provide additional materials as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

3.7 FINAL COMMISSIONING REPORT DOCUMENTATION

Assist the Commissioning Agent in compiling supportive documentation for submission of a Final Commissioning Report. The report will summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process.

3.8 DEFERRED TESTING

3.8.1 Unforeseen Deferred Tests

If a test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon recommendation of the Commissioning Agent and the approval of the Contracting Officer. Conduct these tests in the same manner as the seasonal tests as soon as possible.

3.8.2 Deferred Tests

Schedule, coordinate, observe, and document additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the system and controls. Complete testing during the warranty period to fully test all sequences of operation.

3.8.3 End-of-Warranty Review

The Commissioning Agent will conduct end of warranty review 8 to 10 months prior to the end of the warranty period. Review the current building operation with the facility maintenance staff. Include in the review all outstanding issues from original or seasonal testing; interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist Contracting Officer in developing reports or documentation to remedy problems. Warranty issues identified at this time will be communicated to the Contractor for correction.

Update O&M manuals and Record Documents as necessary due to the testing.

3.9 EQUIPMENT AND SYSTEM SCHEDULE

Commission the following equipment in this project.

System	Equipment
HVAC System	Heating and Ventilation Units
	High Temperature Exhaust Fans
	Heat Pump
	Crawl Space Make up Air Dampers
	HVAC Controls
	Crawl Space Unit Heaters
	Staging Exhaust Fans
	Stair Compartment Exhaust Fans
	Process Water System
	Tank Liquid Level Control
Propane	Vaporizers
Lighting	Lighting controls
BAS System	Controls serving or interfacing with FFT and FFT Trainer controls
Carbon Dioxide Fire Extinguishing Tank	Carbon Dioxide Fire Extinguishing Tank
Fire Alarm	Fire Alarm Devices serving and specific to the Fire Fighter Trainer
Door operation (all man doors in Fire Fighter Trainer Section)	Door operations to be tested for proper operations, including proper closing and latching - testing to be performed after HVAC system has been completed

Renovate SWOSU Fire Fighter Trainer (Building 510)
Naval Station Great Lakes, Great Lakes, IL

WON 1310337

-- End of Section --

SECTION 02 41 00

DEMOLITION
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 SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 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 (2014; Rev R) Military Marking for Shipment and Storage

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 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. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. 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 until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes the value derived from the salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. The work includes demolition and 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 or pavements to remain. 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

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. 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, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by 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

Contractor and Contracting Officer will develop and schedule sequence of demolition areas, both interior and exterior schedules will allow for appropriate time and duration and will not affect current operation of the facility. See Division 1 Specifications for project milestones and availability of specific areas.

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. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

SD-07 Certificates

Demolition Plan; G
Notification; G

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) or 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. Sweep, vacuum and dust the work areas daily.

1.8 PROTECTION

1.8.1 Traffic Control Signs

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

1.8.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished 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 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.

1.10 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, propane lines, 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 voids, depressions or excavations resulting from demolition of structures. Fill material shall be waste products from demolition or deconstruction until all waste appropriate for this purpose is consumed.

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 as noted on drawings.
- b. 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. 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.

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 on the station 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

Remove sawcut concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 9 inches below existing adjacent 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 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 where indicated in their entirety down to existing roof deck. 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.

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 Concrete

Saw cut concrete walls along straight lines to a depth as not to cut or damage existing reinforcing. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Chip out the concrete within the saw cut border and around all reinforcing bars as

indicated in drawings. Remaining concrete to be of sound condition before patch work begins.

3.1.7 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel. Do not use flame-cutting torches. Transport girders as whole units and not dismantled. Transport structural steel shapes to a designated recycling facility, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.8 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, metal gutters, roofing, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property and shall be removed from the site. 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.

3.1.9 Resinous Flooring

Remove existing resinous flooring, including integral cove base as indicated on demolition drawing. Removal of existing resinous flooring shall comply with manufacturer's recommendations for removal, and preparation for new resinous flooring, including but not limited to concrete surface preparation in order to achieve proper adhesion of new flooring surface cove base.

3.1.10 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: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing equipment, with an approved concrete patching material, applied in accordance with the manufacturer's printed instructions. Patch concrete walls as indicated on drawings.

3.1.11 Air Conditioning Equipment

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."

3.1.12 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)."

3.1.13 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.

3.1.13.1 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.

3.1.13.2 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.

3.1.13.3 Ducts

Classify removed duct work as scrap metal.

3.1.13.4 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.

3.1.14 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment unless otherwise noted. 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.

3.1.14.1 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.

3.1.15 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

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

- 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 and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy as directed by the Commanding Officer.

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 removed from Government property and disposed of in accordance with 40 CFR 82. 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.

3.3.4.1 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
- e. National stock number (for information, call (804) 279-4525).

3.3.5 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.

3.3.6 Unsalvageable and Non-Recyclable Material

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 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 03 01 30.71

CONCRETE REHABILITATION

04/06

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.

ASTM INTERNATIONAL (ASTM)

ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2014a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C881/C881M	(2013) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.2 DEFINITIONS

1.2.1 Epoxy Resin Binder

A two-component epoxy bonding system in low and medium viscosities used by itself as a primer or for producing epoxy concrete or mortars when mixed with aggregate.

1.2.2 Non-Pressure Epoxy Grout

A combination of epoxy resin binder, a mineral filler and a thixotropic agent used in cementing dowels in place and the repair of non-structural cracks.

1.2.3 Pressure Grouting Epoxy

A low viscosity epoxy resin system pumped under pressure into structural cracks in walls or pavements.

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-05 Design Data

Job mix formula

SD-06 Test Reports

Sieve analysis test for aggregate

Epoxy resin binder tests

Epoxy grout tests

SD-08 Manufacturer's Instructions

Epoxy repair material

Submit for mixing and applying.

1.4 QUALITY ASSURANCE

1.4.1 Design Data

1.4.1.1 Job Mix Formula

Submit, at least 15 days before work commences, a job-mix formula for each use of epoxy concrete. Test reports shall accompany the mix design. Identify the proposed source of the materials and state the proportions of aggregates and epoxy resin. When determining job mix, use samples of materials to be used on the job.

- a. Trial batches: Perform a minimum of three trial batchings in a certified testing laboratory. Try different aggregate-resin proportions to obtain satisfactory placing and finishing characteristics but keep the proportion by weight of aggregate to epoxy resin binder at least five to one. When mixing, add the fine aggregates first, and then the coarse aggregates. The final trial batch should be sufficiently wet so that some fines will "bleed" to the surface during finishing operations.
- b. Supporting criteria: Include in the submittal the following data for each trial batch:
 - (1) Proportions by weight
 - (2) Unit weights and specific gravities of constituents
 - (3) Batch weights
 - (4) Compressive strengths of 3 by 6 inch cylinders, made in accordance with ASTM C31/C31M, air cured for 7 days and tested in accordance with ASTM C39/C39M. Compressive strength shall be a minimum of 4500 psi.
 - (5) Curing time

1.4.2 Test Reports

1.4.2.1 Epoxy Resin Binder

Include the following:

- a. Viscosity
- b. Consistency

- c. Gel time
- d. Absorption
- e. Shrinkage
- f. Thermal compatibility

1.4.2.2 Epoxy Resin Grout

Include the following:

- a. Epoxy number
- b. Consistency
- c. Compressive single shear strength
- d. Pot life

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to site for damage, unload and store with a minimum of handling. Deliver epoxy resin components and aggregate materials in original sealed containers and store in dry covered areas at temperatures below 90 degrees F. Remove from job site unused mixed materials which have reached end of working or pot life.

1.6 WEATHER LIMITATIONS

Halt work when weather conditions detrimentally affect the quality of patching or bonding concrete. Apply epoxy resin materials only when the contact surfaces are completely dry and if the atmospheric and surface temperature ranges are suitable for the specified epoxy material. Follow manufacturer's instructions for weather conditions and temperature ranges.

1.7 TRAFFIC CONTROL

Do not permit vehicular or heavy equipment traffic on the pavement in the work area during the curing period. At the end of the curing period, light local traffic may be permitted on the pavement if approved by the Contracting Officer.

1.8 EQUIPMENT

Use a container recommended by the epoxy manufacturer as the mixing vessel. Use a power drive (air or spark-proof) propeller type blade for mixing except that hand mixing may be used for small batches. Use equipment specified by epoxy manufacturer for field mixing of aggregates and epoxy resin.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Epoxy

2.1.1.1 Epoxy Resin Binder for Concrete

For slabs use ASTM C881/C881M, Type III, Grade 1, Class B without mineral filler. For walls use ASTM C881/C881M, Type III, Grade 3, Class B with filler.

2.1.1.2 Non-Pressure Epoxy Grout

ASTM C881/C881M Type IV, Grade 3, Class B with or without mineral filler.

2.1.1.3 Crack Sealer for Pressure Grouting Slabs

ASTM C881/C881M, Type IV, Grade 1, Class B without filler.

2.1.1.4 Crack Surface Sealer for Pressure Grouting Walls

ASTM C881/C881M, Type IV, Grade 3, Class B with mineral filler.

2.1.2 Aggregate

For material passing No. 200 sieve provide a non-plastic material composed of a minimum of 75 percent limestone dust, talc or silica inert filler. Provide dry aggregate.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Epoxy Grout for Cracks

Apply grout to newly exposed concrete free of loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy grout.

3.2 MIXING MATERIALS

Make batches small enough to ensure placement before binder sets. Mix materials in accordance with manufacturer's recommendations.

3.3 PLACEMENT

3.3.1 Non-Pressure Epoxy Grout

3.3.1.1 Cementing Dowels

Immediately prior to placing the dowel, clean hole of dust and other deleterious material with a high pressure air hose. Fill hole halfway with grout. Insert dowel in hole by rotating it at least one complete turn while tapping it down. If necessary add more grout to fill hole.

3.3.1.2 Epoxy Grout for Cracks

Apply epoxy grout at a thickness recommended by the manufacturer. Work grout into place and consolidate thoroughly so that contact surfaces are wetted by the grout. Finish surface of grout to the required texture. Do not feather edge epoxy grout onto adjacent surfaces.

3.3.2 Pressure Grouting of Cracks

Clean each crack of dust, dirt, loose concrete and unsound material. Insert a valve at both ends of each crack, at the junction of two cracks, and along the length of each crack at 16 to 20 inch intervals. Fill crack between valves with crack surface sealer. After crack surface sealer has hardened and cured, pump crack sealer into valve at one end of crack. For vertical surfaces start at lowest valve and work upwards. As crack sealer appears at next valve, pinch closed pumping valve and move to next valve and commence pumping. Continue procedure until other end of crack is reached. Avoid delays in pumping operation. After crack sealer has hardened and cured grind valves off flush with concrete surface. Coat areas of valves with crack surface sealer and allow to harden and cure.

3.4 CURING

Cure epoxy materials in accordance with manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

As soon as epoxy resin and aggregate materials are available for sampling, obtain by random selection a sample of each batch. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use and quantity involved.

3.5.2 Testing

At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification.

3.5.3 Inspection

Check each repaired area for cracks, spalls, popouts and loss of bond between repaired area and surrounding concrete. Check each repaired area for voids by tapping with a hammer or steel rod and listening for dull or hollow sounds. Immediately repair defects.

-- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

05/14

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 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(2014) Guide for Structural Lightweight-Aggregate Concrete
ACI 301	(2010; Errata 2011) Specifications for Structural Concrete
ACI 302.1R	(2004; Errata 2006; Errata 2007) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(1996; R 2008) Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 306R	(2010) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 318	(2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and

Commentary

ACI 347	(2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References
ACI SP-2	(2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
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ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2014) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615/A615M	(2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	(2014) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A934/A934M	(2013) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	(2014a) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1017/C1017M	(2013) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	(2014) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1107/C1107M	(2014) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1157/C1157M	(2011) Standard Specification for

Hydraulic Cement

ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C138/C138M	(2014) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
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 C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2014) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2014) 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 C295/C295M	(2012) Petrographic Examination of Aggregates for Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	(2013) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C330/C330M	(2014) Standard Specification for Lightweight Aggregates for Structural Concrete

ASTM C39/C39M	(2014a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2013) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C567/C567M	(2014) Determining Density of Structural Lightweight Concrete
ASTM C595/C595M	(2014) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2012; E 2013) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2014) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2628	(1991; R 2011) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2012) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D5759	(2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D6690	(2012) Standard Specification for Joint and Crack Sealants, Hot Applied, for

Concrete and Asphalt Pavements

ASTM E329 (2014a) Standard Specification for
Agencies Engaged in the Testing and/or
Inspection of Materials Used in
Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2009; 28th Ed) Manual of Standard Practice

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1 (2009) DOC Voluntary Product Standard PS
1-07, Structural Plywood

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and .
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.
- d. "Supplementary cementing materials" (SCM) include coal fly ash, granulated blast-furnace slag, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.
- e. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.
- g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.
- h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.
- i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

- j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

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

- Concrete Curing Plan
- Quality Control Plan
- Quality Control Personnel Certifications
- Quality Control Organizational Chart
- Laboratory Accreditation

SD-02 Shop Drawings

- Reinforcing steel

SD-03 Product Data

- Joint sealants
- Joint filler
- Cementitious Materials
- Concrete Curing Materials
- Reinforcement
- Admixtures

SD-05 Design Data

- Concrete mix design; G

SD-06 Test Reports

- Concrete mix design; G
- Fly ash
- Pozzolan
- Aggregates
- Compressive strength tests; G
- Unit weight of structural concrete
- Air Content
- Slump Tests
- Water

SD-07 Certificates

Reinforcing Bars

Material Safety Data Sheets

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Curing Compound

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor retarder, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, complementary cementitious materials, , and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, complementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one

mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Reinforcing Steel

ACI SP-66. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

1.6.3.2 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. MSDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Aggregates

ASTM C1260 for potential alkali-silica reactions, ASTM C295/C295M for petrographic analysis.

1.6.5 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier. Maintain a copy of ACI SP-15 and CRSI 10MSP at project site.

1.6.6 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the

various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

- a. CQC personnel responsible for inspection of concrete operations.
- b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.
- c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

1.6.6.1 Quality Manager Qualifications

The quality manager must have experience on at least five (5) similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.6.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

- a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.
- b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.
- c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

1.6.7 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.8 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a registered professional engineer in a U.S. state or territory competent in concrete materials who is competent in concrete materials and must sign all reports and designs.

- b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.
- c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

- a. Provide data indicating the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.
- b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.
- c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.
- d. Provide product data stating the location where all products were manufactured
- e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.
- f. For projects using reusable formwork, provide data showing how formwork is reused.
- g. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- h. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

Provide a form tie system that does not leave mild steel after break-off or removal any closer than 2 inches from the exposed surface. Do not use wire alone. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.3 CONCRETE MIX DESIGN

2.3.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318 and ACI 211.2 ACI 304.2R and ACI 213R except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) as specified below. Where faster set time is required, use Type III cement before using calcium chloride with approval from the contracting officer.

2.3.1.1 Interior Concrete

Proportion light-weight concrete mixture as follows:

- a. Minimum Compressive Strength: 5000 psi at 28 days.
- b. Maximum Water-Cementitious Materials Ratio: 0.45 .
- c. Slump Limit: 4 inches maximum (before adding high-range water-reducing admixture.)
- e. Aggregate: 3/8-inch nominal maximum aggregate size.

2.3.1.2 Exterior Concrete

Proportion normal-weight concrete mixture as follows:

- a. Minimum Compressive Strength: 4500 psi at 28 days.
- b. Maximum Water-Cementitious Materials Ratio: 0.45 .
- c. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
- e. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/8-inch nominal maximum aggregate size. Do not add air to trowel finished slabs
- f. Aggregate: 3/8-inch nominal maximum aggregate size.

2.3.1.3 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI 211.1. In the trial mixture, use at least three different water-cementitious material ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cementitious material ratio allowed must be based on equivalent water-cementitious material ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cementitious material ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M for 7, 28, days. From these results, plot a curve showing the relationship between water-cementitious

material ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.4 Lightweight Concrete Proportion

ACI 211.2, using weight method. Provide ASTM C330/C330M aggregates for concrete.

2.3.1.5 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301, but may not exceed the specified strength at the same age by more than 20 percent. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI 301.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

Type and brand cement

Cement and complementary cementitious materials content in 94-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water cementitious material ratio

2.3.3 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufacturer's instructions for placement of curing compound.

2.4 MATERIALS

2.4.1 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash

ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent.

Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount

of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permissible that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.4.1.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

2.4.1.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.
- b. The average particle size must not exceed 6 microns.
- c. The sum of SiO₂ + Al₂O₃ + Fe₂O₃ must be greater than 77 percent.

2.4.1.4 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type I/II, low alkali including false set requirements with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na₂O_e (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.1.5 Blended Cements

Blended cement must conform to ASTM C595/C595M and ASTM C1157/C1157M, Type IP or IS, including the optional requirement for mortar expansion and sulfate soundness and consist of a mixture of ASTM C150/C150M Type I, or Type II cement and a complementary cementing material. The slag added to the Type IS blend must be ASTM C989/C989M ground granulated blast-furnace slag. The pozzolan added to the Type IP blend must be ASTM C618 Class F and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of mineral admixture used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.4.2 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

2.4.3 Aggregates

ASTM C33/C33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement. Submit test report showing compliance with ASTM C33/C33M.

Fine and coarse aggregates must show expansions less than 0.08 percent at 28 days after casting when testing in accordance with ASTM C1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious
2. Fly ash or natural pozzolan at a minimum of total cementitious of
 - a. 30 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 65 percent or more,
 - b. 25 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 70 percent or more,
 - c. 20 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 80 percent or more,
 - d. 15 percent if (SiO₂ plus Al₂O₃ plus Fe₂O₃) is 90 percent or more.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 28 days after casting when tested in accordance with ASTM C1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C295/C295M.

2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

ASTM C33/C33M, uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

2.4.3.2 Aggregates for Lightweight Concrete

ASTM C330/C330M.

2.4.4 Nonshrink Grout

ASTM C1107/C1107M.

2.4.5 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Submit product data for admixtures used in concrete.

2.4.5.1 Air-Entraining

ASTM C260/C260M.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C494/C494M, Type F and Type G (HRWR retarding admixture) and
ASTM C1017/C1017M.

2.4.6 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or II. Material must be 1/2 inch thick,
unless otherwise indicated.

2.4.7 Joint Sealants

2.4.7.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.4.7.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T ..

2.4.7.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

2.4.7.4 Lubricant for Preformed Compression Seals

ASTM D2835.

2.4.8 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

2.5 REINFORCEMENT

2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. Use deformed steel. ASTM A615/A615M with the bars marked A, Grade 60; or ASTM A996/A996M with the bars marked R, Grade 60, or marked A, Grade 60. Submit mill certificates for reinforcing bars.

2.5.1.1 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

2.5.3.1 Welded Wire Reinforcement

ASTM A1064/A1064M. Provide flat sheets of welded wire reinforcement for slabs and toppings.

2.5.3.2 Steel Wire

Wire must conform to ASTM A1064/A1064M.

2.5.4 Reinforcing Bar Supports

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place.

Provide wire bar type supports of coated or non-corrodible material conforming to ACI SP-66 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are level.

If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials.

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

Provide forms, shoring, and scaffolding for concrete placement in accordance with ACI 301 Section 2 and 5 and ACI 347. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris.

3.3.1 Coating

Before concrete placement, coat the contact surfaces of forms with a form release agent.

3.3.2 Reshoring

Reshore concrete elements in accordance with ACI 301 Section 2.

3.3.3 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious

material ratio paste.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view.

3.3.6 Form Ties

Provide ties in accordance with ACI 301 section 2.

3.3.7 Forms for Concrete Pan Joist Construction

Pan-form units for one-way or two-way concrete joist and slab construction must be factory-fabricated units of the approximate section indicated. Units must consist of steel or molded fiberglass concrete form pans. Closure units must be furnished as required.

3.3.8 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI 301 Section 5 and ACI 117.

3.3.9 Removal of Forms and Supports

After placing concrete, removal of forms must be in accordance with ACI 301 Section 2 except as modified by approved form removal schedule.

3.4 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301 and ACI SP-66. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.4.1 General

Provide details of reinforcement that are in accordance with ACI 301 and ACI SP-66 and as specified.

3.4.2 Reinforcement Supports

Support reinforcement in accordance with ACI 301 Section 3. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

3.4.3 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

3.4.4 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.4.5 Setting Miscellaneous Material

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

3.4.6 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI 318 and ACI SP-66.

Provide hooks and bends that are in accordance with ACI 318 and ACI SP-66.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI SP-66.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

- a. Bar lengths, depths, and bends beyond specified fabrication tolerances
- b. Bends or kinks not indicated on drawings or approved shop drawings
- c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.4.7 Placing Reinforcement

Place reinforcement in accordance with ACI 301 and ACI SP-66.

For slabs on grade (over earth or over capillary water barrier) and for

footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 318, ACI SP-66 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire reinforcement as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI SP-66.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in ACI SP-66 and ACI 318.

3.4.8 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the ACI 318 and ACI SP-66.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.4.9 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI 318 and ACI SP-66.

3.4.10 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.5 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.5.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.5.2 Mixing

ASTM C94/C94M, ACI 301 and ACI 304R. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.5.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.6 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

3.6.1 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.6.1.1 Pumping Lightweight Concrete

ACI 213R. Presoak or presaturate aggregates. Cement content must be

minimum of 564 pounds per cubic yard and be sufficient to accommodate a 4 to 6 inch slump. Make field trial run in accordance with ACI 213R.

3.6.2 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.6.3 Hot Weather

Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.6.4 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

3.7 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.7.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.7.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement.

3.7.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.7.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier.

3.8 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.8.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

3.8.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.8.3 Formed Surfaces

3.8.3.1 Tolerances

ACI 117 and as indicated.

3.8.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

3.8.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

3.9 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor must provide straightedge.

3.9.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper

contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.9.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.9.1.2 Floated

Use for exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.9.1.3 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.9.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Finish concrete in accordance with ACI 301 Section 5 for a dry-shake finish. After the selected material has been embedded by the two floatings, complete the operation with a broomed finish.

3.9.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.9.2 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.9.3 Curbs

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

3.10 JOINTS

3.10.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.10.1.1 Maximum Allowable Construction Joint Spacing

- a. In walls at not more than 60 feet in any horizontal direction.
- b. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet.

3.10.1.2 Construction Joints for Constructability Purposes

- a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.10.2 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.10.3 Contraction Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.

Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

Sawcutting will be limited to within 12 hours after set and at 1/4 slab

depth.

3.10.4 Sealing Joints in Slabs on Ground

Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.11 CURING AND PROTECTION

ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.2 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.3 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.4 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.5 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.6 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.7 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge.

The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F

) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C39/C39M. Make six 6 inch by 12 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold two cylinder in reserve. Take samples for strength tests of each concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of ACI 318 Section 5.6. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete and ASTM C173/C173M for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Unit Weight of Structural Concrete

ASTM C567/C567M and ASTM C138/C138M. Determine unit weight of lightweight and normal weight concrete. Perform test for every 20 cubic yards maximum.

3.12.2.6 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.12.2.7 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.12.2.8 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes

recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.13.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

3.13.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.13.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL

05/14

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
AISC 325	(2011) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2010) Specification for Structural Steel Buildings
AISC DESIGN GUIDE 10	(1997) Erection Bracing of Low-Rise Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel
AWS D1.8/D1.8M	(2009) Structural Welding Code—Seismic Supplement

ASME INTERNATIONAL (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay
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ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	(2007; R 2014) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

Strength

ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A490	(2012) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M	(2013) 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 A563	(2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A6/A6M	(2014) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2009) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1107/C1107M	(2014) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F1554	(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2014) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM F2329	(2013) Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959	(2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013) Structural Engineering
UFC 3-310-04	(2013) Seismic Design for Buildings

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

Erection Drawings; G

SD-02 Shop Drawings

Fabrication drawings including description of connections; G

SD-03 Product Data

Welding electrodes and rods

Direct Tension Indicator Washers

Non-Shrink Grout

Tension control bolts

SD-06 Test Reports

Bolts, nuts, and washers

Weld Inspection Reports

Direct Tension Indicator Washer Inspection Reports

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Welding procedures and qualifications

Welding electrodes and rods

1.3 QUALITY ASSURANCE

1.3.1 Preconstruction Submittals

1.3.1.1 Erection Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

1.3.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Any deviations from the details shown on the contract drawings must be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.3.3 Certifications

1.3.3.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M and AWS D1.8/D1.8M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing must be provided in accordance with AISC 360, UFC 3-301-01 and UFC 3-310-04 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2.2.1.1 Refractory Panel Steel Plate Shielding

ASTM A36/A36M.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade B.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard).

2.3 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.1.2 Nuts

ASTM A563M, Grade A, heavy hex style.

2.3.1.3 Washers

ASTM F844.

2.3.2 High-Strength Bolts

2.3.2.1 Bolts

ASTM A325, Type 1 ASTM A490, Type 1 or 2.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Direct Tension Indicator Washers

ASTM F959. Provide ASTM B695, Class 50, Type 1 galvanizing.

2.3.2.4 Washers

ASTM F436, plain carbon steel.

2.3.3 Tension Control Bolts

ASTM F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be plain or mechanically deposited zinc coating.

2.3.4 Foundation Anchorage

2.3.4.1 Anchor Rods

ASTM F1554 Gr 36 , Class 1A .

2.3.4.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.4.3 Anchor Washers

ASTM F844 .

2.3.4.4 Anchor Plate Washers

ASTM A36/A36M

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.4.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage.

2.5 GALVANIZING

ASTM F2329 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

2.6.1 Markings

Prior to erection, members must be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.7 DRAINAGE HOLES

Adequate drainage holes must be drilled to eliminate water traps. Hole diameter must be 1/2 inch and location must be indicated on the detail drawings. Hole size and location must not affect the structural integrity.

PART 3 EXECUTION

3.1 ERECTION

- a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325.
- b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the structure must be erected in accordance with AISC DESIGN GUIDE 10.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.1.1 STORAGE

Material must be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, connections not detailed must be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

ASTM A307 bolts must be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM A325 and ASTM A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, the DTIW must be installed under the bolt head and the nut must be tightened. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the DTIW, provide flat washers under both the bolt head and nut when ASTM A490 bolts are used.

3.2.3 Tension Control Bolts

Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified must be submitted for approval.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas. Remove backing strips from bottom flange of moment connections, backgouge the root pass to sound weld metal and reinforce with a 5/16 inch fillet weld minimum.

3.5 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.6 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer must be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.6.1 Welds

3.6.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections.

Inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.

3.6.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Test locations must be as indicated. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder must be tested by ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing must be used only in areas inaccessible to ultrasonic testing. Retest defective areas after repair. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Ultrasonic	15% of Groove Welds
Magnetic Particle	20% of Fillet & Butt Welds

3.6.2 Direct Tension Indicator Washers

3.6.2.1 Direct Tension Indicator Washer Compression

Direct tension indicator washers must be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the direct tension indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the direct tension indicator washer is placed under the turned element, as required by ASTM F959. Submit direct tension indicator washer inspection reports.

3.6.3 High-Strength Bolts

3.6.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.6.3.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspect calibration of torque wrenches for high-strength bolts.

3.6.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.6.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication. Submit embrittlement test reports.

-- 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 (2013) 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; 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 B18.21.1 (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 (2013) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2013) 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 A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A467/A467M	(2007; R 2012) Standard Specification for Machine Coil Chain
ASTM A47/A47M	(1999; R 2014) 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 A653/A653M	(2013) 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	(2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
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

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
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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 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

Fabrication drawings of structural steel door frames; G

Safety Chains; G

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.

SD-03 Product Data

Safety chains

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, ASTM A992/A992M.

2.1.2 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.3 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.4 Anchor Bolts

2.1.4.1 Expansion Anchors

Provide as noted on drawings.

2.1.4.2 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.4.3 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.4.4 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.4.5 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.

2.2 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.

2.3 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide as indicated on drawings with steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.4 RIVETED STEEL GRATING

Refer to Section 05 53 14 RIVETED STEEL GRATING.

2.5 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain as indicated on drawings. Mount as indicated on drawings.

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; machine and carriage bolts for steel. 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 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.

3.7 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

3.8 MOUNTING OF SAFETY CHAINS

Mount safety chains as indicated on drawings.

-- End of Section --

SECTION 05 53 14

RIVETED STEEL GRATING
01/15

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 WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M (2014) 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

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (2009) Metal Bar Grating Manual

NAAMM MBG 532 (2009) Heavy Duty Metal Bar Grating Manual

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Fabrication and erection drawings; G
Anchor details and installation details; G
Welding of Structural Steel
Structural Steel Welding Repairs

SD-03 Product Data

Load tables; G

SD-06 Test Reports

Tests, Inspections, and Verifications

SD-07 Certificates

Welding Qualifications

1.3 QUALITY ASSURANCE

Comply with applicable provisions and recommendations of the following:
NAAMM Metal Bar Grating Manual designated ANSI/NAAMM MBG 531 for Steel,
Stainless Steel and Aluminum Gratings and Stair Treads.
The contractor shall take field dimensions to verify "as built" conditions
to ensure proper fit of grating.

1.3.1 Welding Qualifications

Prior to welding, submit certification for each welder stating the type of
welding and positions qualified for, the code and procedure qualified
under, date qualified, and the firm and individual certifying the
qualification tests. Conform to all requirements specified in
AWS D1.1/D1.1M.

1.4 DELIVERY, STORAGE & 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 GENERAL

Grating shall be unfinished steel as noted in drawings and conform to
ASTM A1011/A1011M. Bearing bars shall be of steel as specified. They shall
be rectangular in shape and be of the appropriate depth and thickness as
noted in drawings. Reticuline bars shall be of steel rectangular in shape,
formed in a crimped pattern, connecting to the bearing bars and riveted as
indicated on drawings.

Grating at fireplaces will be exposed to direct flames with maximum
temperature of 1650 degrees F. The uniform load shall be 100 pounds per
square foot, the deflection shall not exceed 1/4 inch over the required
span.

2.2 MATERIALS

2.2.1 Grating

Metal bar type grating NAAMM MBG 532.

2.3 FABRICATION

2.3.1 Structural Fabrication

Material must be straight before being laid off or worked. Perform
straightening, if necessary, by methods that will not impair the metal.
Sharp kinks or bends will be cause for rejection of the material. Material
with welds will not be accepted except where welding is definitely
specified, indicated or otherwise approved. Make bends using approved dies,
press brakes or bending rolls. Where heating is required, take precautions
to avoid overheating the metal and allow it to cool in a manner that will
not impair the original properties of the metal. Proposed flame cutting of
material, other than structural steel, is subject to approval and must be
indicated on detail drawings. Shearing shall be accurate and all portions
of the work neatly finished. Make corners square and true unless otherwise

shown. Provide finished members free of twists, bends and open joints.

2.3.1.1 Dimensional Tolerances for Structural Work

Measure dimensions using an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit must be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled; component members without milled ends must not deviate from the dimensions shown by more than 1/16 inch for members 30 feet or less in length, and by more than 1/8 inch for members over 30 feet in length.

PART 3 EXECUTION

3.1 SHOP FABRICATION

All required cutting, fitting and welding shall be performed in the manufacturers shop in accordance with the approved shop drawings and shall be in compliance with the NAAMM Metal Bar Grating Manual tolerance and welding standards.

All cutouts to clear obstructions shall have a recommended clearance of 1/2 inch. When banding and toe plates are required they shall be welded to the grating in accordance with NAAMM standards.

3.2 GENERAL INSTALLATION

The grating shall be received at the job site by the contractor, unloaded and protected from damage prior to the requirement for it to be installed.

The installing contractor shall prepare the site for installation; determine that deviations from the approved drawings are corrected prior to grating placement.

Grating shall be installed in accordance with the approved shop drawings and the installation clearances called for in the NAAMM Metal Bar Grating Manual including the use of the prescribed anchor system.

-- 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 FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T101 (2005) National Design Specification (NDS)
for Wood Construction

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2010) American Softwood Lumber Standard

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK (2012) AWPA Book of Standards

AWPA M2 (2011) Standard for Inspection of Treated
Wood Products

AWPA M6 (2013) Brands Used on Preservative Treated
Materials

AWPA P18 (2014) Nonpressure Preservatives

AWPA P49 (2010) Standard for Fire Retardant FR-1

AWPA P5 (2014) Standard for Waterborne
Preservatives

AWPA T1 (2014) Use Category System: Processing and
Treatment Standard

AWPA U1 (2014) Use Category System: User
Specification for Treated Wood

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 (2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM D2898 (2010) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

ASTM F1667 (2013) Driven Fasteners: Nails, Spikes, and Staples

ASTM F547 (2006; R 2012) Nails for Use with Wood and Wood-Base Materials

FM GLOBAL (FM)

FM 4435 (2013) Roof Perimeter Flashing

GREEN SEAL (GS)

GS-36 (2011) Commercial Adhesives

U.S. DEPARTMENT OF COMMERCE (DOC)

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)

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

Nailers and Nailing Strips; G

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Fire-retardant treatment
Preservative Treatment
Certificates of Grade
Adhesives

Submit documentation verifying that no urea-formaldehyde resins were used.

SD-06 Test Reports

Preservative-treated lumber and plywood

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. 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 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.

1.4.3 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber shall be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

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

1.7 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products shall conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products shall not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products shall not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and shall not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards.

- a. 0.25 pcf intended for above ground use.
- b. The following items shall be preservative treated:
 1. Wood members that are in contact with water.
 2. Wood furring and nailers that are set into or in contact with concrete or masonry.
 3. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.7.1 Existing Structures

Use borate, permathrin, or a sodium silicate wood mineralization process to treat wood. Use borate for interior applications only.

1.7.2 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

1.8 FIRE-RETARDANT TREATMENT

Fire-retardant treated wood shall be pressure treated with fire retardants conforming to AWPA P49. Fire retardant treatment of wood products shall conform to the requirements of AWPA U1, Commodity Specification H and AWPA T1, Section H. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D2898 prior to being tested. Such items which will not be inside a building, and such items which will be exposed to heat or high humidity, shall receive exterior fire-retardant treatment.

1.9 QUALITY ASSURANCE

1.9.1 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 MATERIALS

2.1.1 Virgin Lumber

Lumber fabricated from old growth timber is not permitted. Avoid companies who buy, sell, or use old growth timber in their operations, when possible.

2.2 OTHER MATERIALS

2.2.1 Hardboard Underlayment

DOC/NIST PS58, service class, sanded on one side, 1/4 inch thick 4 feet wide.

2.2.2 Miscellaneous Wood Members

2.2.2.1 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 3
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.

2.2.2.2 Blocking

Blocking shall be standard or number 2 grade.

2.2.3 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36 and as specified. Use water-based adhesives with maximum VOC content of 15 grams/liter for all interior applications.

2.3 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. 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.

2.3.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.3.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.3.3 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.

2.3.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.3.5 Wood Screws

ASME B18.6.1.

2.3.6 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 AF&PA T101. 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 AF&PA T101. 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.

2.3.7 Wire Nails

ASTM F1667.

2.3.8 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated steel conforming to ASTM A653/A653M, G90. Steel shall be not lighter than 18 gage. Special nails supplied by the manufacturer shall be used for all nailing.

2.3.9 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.1.1.1 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. Strips shall be surface applied.

- 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.

- 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.

3.1.1.2 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.

3.1.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, and wood nailers bolted to tops of concrete or masonry curbs as indicated, specified, or necessary and of lumber or exterior plywood.

3.1.2 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.

3.1.3 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 offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

-- End of Section --

SECTION 07 22 00

ROOF AND DECK INSULATION

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 FOREST AND PAPER ASSOCIATION (AF&PA)

AF&PA T101 (2005) National Design Specification (NDS)
for Wood Construction

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M (2009) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM C1177/C1177M (2008) Standard Specification for Glass
Mat Gypsum Substrate for Use as Sheathing

ASTM C1289 (2014a) Standard Specification for Faced
Rigid Cellular Polyisocyanurate Thermal
Insulation Board

ASTM C 726 (2011) Mineral Fiber Roof Insulation Board

ASTM C665 (2012) Mineral-Fiber Blanket Thermal
Insulation for Light Frame Construction
and Manufactured Housing

ASTM C728 (2005; R 2010) Perlite Thermal Insulation
Board

ASTM D 1623 (2009) Tensile and Tensile Adhesion
Properties of Rigid Cellular Plastics

ASTM D4263 (1983; R 2005) Indicating Moisture in
Concrete by the Plastic Sheet Method

ASTM E84 (2014) Standard Test Method for Surface
Burning Characteristics of Building
Materials

ASTM F 547 (2006) Nails for Use with Wood and
Wood-Base Materials

ASME INTERNATIONAL (ASME)

ASME B18.6.1 (1981; R 2008) Wood Screws (Inch Series)

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA P5 (2014) Standard for Waterborne
Preservatives

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/>

FM P9513 (2002) Specialist Data Book Set for
Roofing Contractors; contains 1-22 (2001),
1-28 (2002), 1-29 (2002), 1-28R/1-29R
(1998), 1-30 (2000), 1-31 (2000), 1-32
(2000), 1-33 (2000), 1-34 (2001), 1-49
(2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (2012) Building Materials Directory

1.2 SUMMARY

Section includes board insulation.

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

SD-02 Shop Drawings

Wood nailers
Tapered roof insulation system; G

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

SD-03 Product Data

Fasteners; G
Insulation; G

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

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

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

1.4 MANUFACTURER'S CERTIFICATE

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

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.5 QUALITY ASSURANCE

1.5.1 Insulation on Concrete Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM APP GUIDE. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.5.2 Insulation for Cool Roofing

Where indicated on Drawings, provide thermal insulation above the roof deck with an average R value of 30 or greater at areas over conditioned spaces.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

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

- a. Name of manufacturer;
- b. Brand designation;

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

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

1.6.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

1.7 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

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

- a. Expanded Perlite Board: ASTM C728. Minimum 3/4 inch thick when both top and bottom surfaces will be in contact with asphalt. For use in repair areas to match existing roof system.
- b. Polyisocyanurate Board: ASTM C1289 Type II, glass mat membrane both sides, minimum compressive strength shall be 20 pounds per square inch (psi).
- c. Fiberglass Rigid Board: ASTM C 726 for thickness up to 1-inch; espousals treated fiber glass scrim reinforced with kraft paper facer. Compressive strength 12 psi.
- d. ASTM C665, Type I, blankets without membrane coverings; a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.1.2 Insulation Thickness

As necessary to provide a thermal resistance (R value) of 30 or more over conditioned space. Thickness shall be based on the LTTR "R" value published.

2.1.3 Tapered Roof Insulation

At low slope areas, one layer of the tapered roof insulation assembly shall be factory tapered to a slope of not less than 1/4 inch per foot. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes.

Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

2.2 PROTECTION BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or protection board for torch-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.3 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven. Fasteners for concrete decks shall conform to FM APP GUIDE for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 90 pounds per square foot.

2.3.1 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least one inch but not more than 1 1/2 inches, conforming to FM 4470, and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 90 psf conforming to FM APP GUIDE.

2.4 WOOD NAILERS

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Nailing strips shall be 2 inch nominal.

2.4.1 Pressure Treated Wood

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products shall conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products shall not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products shall not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and shall not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards.

2.4.2 Wood Screws

ASME B18.6.1.

2.4.3 Nails

ASTM F 547, 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 A 153/A 153M. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T101. 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 AF&PA T101. 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 ADHESIVE

Two-component polyurethane adhesive as approved by roof system manufacturer to meet or exceed wind up-lift requirements of the final installed system. Minimum tensile strength of 35 psi per ASTM D 1623.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

- a. Prior to installing any roof system on a concrete deck, conduct a daily test per ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.1.2 Surface Preparation

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

- a. Install wood nailers the same thickness as insulation at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, gutters, and flashing flanges. On decks with slopes of one inch per foot or more, install wood nailers perpendicular to slope for securing insulation and for backnailing of roofing membrane assembly. Space nailers in accordance with approved shop drawings.
- b. Fill or cover cracks or knot holes larger than 1/4 inch in diameter in wood decks as necessary to form an unyielding surface.

3.2 INSULATION INSTALLATION

Apply insulation in multiple layers with staggered joints when total required thickness of insulation exceeds 1.5 inches. Lay insulation so that continuous longitudinal joints are perpendicular to direction of roofing, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 1/4 inch clear of vertical surfaces penetrating and projecting from roof surface. Adhere with polyurethane adhesive to meet the manufacturer's tested system requirements.

3.2.1 Special Precautions for Installation of Foam Insulation

3.2.1.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch thick glass mat gypsum roof board insulation over top surface of foam board insulation. Stagger joints of glass-mat gypsum with respect to foam board insulation below. For sloped areas provide this product over nailers as well as allowed by roof system manufacturer.

3.2.2 Cant Strips

Where indicated, provide wood cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in an approved adhesive.

3.2.3 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in an approved adhesive.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to a 30 psf live load limit. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be one ply of smooth modified membrane set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.3.2 Damaged Work and Materials

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

3.4 INSPECTION

The Contractor shall establish and maintain a third party inspection procedure acceptable to Government to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM P9513.
- c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.
- d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- e. Inspection of mechanical fasteners; type, number, length, and spacing.
- f. Coordination with other materials, cants, sleepers, and nailing strips.
- g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- h. Installation of cutoffs and proper joining of work on subsequent days.
- i. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

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.

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 C1107/C1107M (2014) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM C 1177/C 1177M (2008) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C1289 (2014a) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D2824 (2006) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos

ASTM D4073 (2006) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes

ASTM D41/D41M (2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D6163 (2000; R 2008) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

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 SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1 (2010) Occupational and Educational Personal Eye and Face Protection Devices

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)

CERTA (2003) NRCA/MRCA Certified Roofing Torch Applicator Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241 (2013) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 58 (2014; TIA 13-1; TIA 13-2; Errata 13-1; TIA 13-3; Errata 14-2) Liquefied Petroleum Gas Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Details (2003) NRCA Roof Perimeter Flashing Systems Construction Details for Class 1 Roof Construction

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 (2003) Architectural Sheet Metal Manual, 6th Edition

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

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1910.12 Construction Work

29 CFR 1926 Safety and Health Regulations for Construction

29 CFR 1926.16 Rules of Construction

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Reprint Jul 2014) Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2012) Roofing Materials and Systems Directory

1.2 SUMMARY

Repair existing roof using materials specified in this Section as necessary for complete, water-tight installation. System shall be inspected by third-party and the Roofing Manufacturer during patching procedures and during installation of the entire fluid-applied roofing as required to issue a 20-year warranty.

Refer to Section 07 56 00 FLUID-APPLIED ROOFING.

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

Roof repair plan; G drawing depicting areas where patching, replacement and repair are indicated.

SD-03 Product Data

Modified Bitumen Sheets; G
Primer; G
Torch-Applied Membrane Adhesive; G
Fasteners And Plates; G
Non-Shrink Grout; G
Sample Warranty certificate; G

Submit all data required by Section 07 22 00 ROOF AND DECK INSULATION, together with requirements of this section. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Products must be as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-07 Certificates

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Qualification of Inspector; G

Certify that the Inspector meets requirements specified under paragraph entitled "Qualification of Inspector."

Qualifications for Manufacturer's Technical Representative

Certify that the manufacturer's technical representative meets requirements specified under paragraph entitled "Qualification of Manufacturer's Technical Representative."

SD-08 Manufacturer's Instructions

Modified Bitumen Membrane Application; G
Blister Repair
Open Lap/Seam Repair
Flashing; G
Primer
Fasteners

SD-11 Closeout Submittals

Warranty
Information Card

Include copies of Material Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials for fully replaced roof areas.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer must have a minimum of 5 years experience in manufacturing modified bitumen roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen 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. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Qualification of Inspector

Contractor shall hire full-time third-party Roofing Inspectors for the life of this Contract who will be on site daily during roofing operations to perform Inspection Duties required for proper repair of roof. Inspectors

shall supply names, locations, and client contract information of 5 projects of similar size and scope that the Inspectors have witnessed using the roofing products specified. Qualifications for Inspectors shall include one of the following:

- a. Roofing Inspector must be approved, authorized or licensed in writing by the Roofing Consultants Institute as either a Registered Roofing Consultant or Registered Roofing Observer. Inspector shall have a minimum 10 years experience.
- b. Roofing Inspector must be licensed professional architect or engineer demonstrating 10 years continuous specialized experience in design, investigation, testing, and consulting services related to roofing, waterproofing, and building envelope systems for new and existing structures.

Inspectors shall have a thorough knowledge of roofing details, flashing and systems employing roofing system of existing roof. Roofing inspection shall be a full-time occupation Roofing Inspector. If testing is required, Roof Consultant shall be appropriately trained, certified, and licensed in the testing procedure specified.

1.4.4 Qualifications for Manufacturer's Technical Representative

An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.4.5 Fire Resistance

Patch, repair and replacements made to the existing roof system shall maintain the existing fire rating, including:

- a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790.
- b. Listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.4.6 Wind Uplift Resistance

Patch and repair of the existing roof system assembly, including insulation, shall be capable of withstanding an uplift pressure of 90 psf field of roof, 150 psf perimeter, and 220 psf at corner. Base wind uplift measurements on a design wind speed of 130 mph in accordance with ASCE 7, ASTM D4073, and/or other applicable building code requirements.

1.4.7 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

- a. Drawings, including Roof Repair 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 roof structure, 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 representatives 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.

e. Quality control, (ARMA PMBRG98) plan for the roof system installation.

f. Safety requirements.

Coordinate prerooting conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with ASSE/SAFE A10.24, and 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.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' 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, the container must bear the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 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. 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. All rolls shall be stored on end to prevent deformation of the roll. Deformed rolls shall be removed from Site.

Maintain a minimum distance of 35 foot from all stored flammable materials, including materials covered with shrink wraps, craft paper and/or tarps from all torch/welding applications.

Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 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.

1.6 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.

1.7 TORCH APPLIED MODIFIED BITUMEN MEMBRANE SAFETY

1.7.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during torch application of roofing. Immediately call the fire department if a fire commences. Review all fire safety procedures as outlined at the pre-roofing conference.

Install materials using the techniques recommended by CERTA NRCA/MRCA Certified Roofing Torch Applicator Program available from the National Roofing Contractors Association (NRCA) and the Midwest Roofing Contractors Association (MRCA) as endorsed by the Asphalt Roofing Manufacturers Association (ARMA) and the United Union of Roofers, Waterproofers and Allied Workers. Application procedures must comply with NFPA 241, OSHA 29 CFR 1910 and 29 CFR 1910.12, 29 CFR 1926.16, 29 CFR 1926 Subpart F., UL Fire Resistance Directory Volume No. 1, NRCA R&W Manual, and Florida Building Code Volume 2004.

Do not store flammable liquids on the roof.

Provide a minimum of two 2.65 gallon containers of water and two fully charged minimum 20 pound ABC (dry chemical) fire extinguishers in separate, easily accessible locations on the roof and within 10 foot of each torch work area at all times.

Maintain a minimum separation of 20 foot between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 8 foot and a clear surround distance of 4 foot if operations force placement of kettle within a distance of 20 foot. Do not obstruct or place Cylinder storage within 10 foot of exits, means of egress, gates, roadways, entrances.

Comply with the following safety procedures:

- a. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.

- b. Fuel containers having capacities greater than one pound must be located a minimum of 10 foot clear distance from the burner flame.
- c. All LP-Gas Cylinders must be clearly labeled "Flammable Gas", and secured to prevent accidental tip-over.
- d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.
- e. Turn off fuel supply at LP Gas Cylinder when not in use.
- f. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.
- g. Do not use flammable liquids with a flash point below 100 degrees F (gasoline and similar products) for cleaning purposes.

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during torching applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with non-combustible materials prior to installing torch-applied materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 3 foot radius of the area of torch work prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent flame of torch from being drawn into the opening. Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.

1.7.2 Fire Watch

All personnel on the roof during torch application must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of two hours after completion of all torch work at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. For torch applications, provide and utilize a minimum of one certified heat detection gun per torch for use during the fire watch to verify cool, safe and non-combustible conditions exist. Provide a minimum duration fire watch of two hours conducted by personnel properly trained to survey the underside of the roof deck (where possible) and the topside of possible smoldering elements.

Do not torch in areas of poor and/or no visibility (curbs, corners, eaves, expansions joints, flashing, other voids and small penetrations) which

could allow a torch flame to ignite combustible material(s) hidden from view or within the underside of the roof deck or building interior.

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.7.3 Open Flame Application (Torch) Equipment and Personnel Safety

Only NRCA/MRCA CERTA certified roofing applicators are allowed to operate any torching equipment. Verify that all such applicators maintain and are currently carrying a valid Certified Roofing Torch Applicator (CERTA) card.

All crew members must be trained in preventive measures for indirect and direct dangers and hazards associated with roofing work, which include, but are not limited to the following:

- a. Heat Stress: Wear light colored clothing, a hat for ultra-violet protection, and other eye protective devices. Drink sufficient quantities of non-alcoholic, non-caffeine liquids. Stage shifts for crew members to allow for breaks from heat and sun exposure without interfering with work progress.
- b. First Aid for Burns: Immediately call for an ambulance. Contact local Occupational Health Services (OHS).

All crew members must wear correct personal protective equipment (PPE), including, but not limited to the following items:

- a. Long-sleeved shirts buttoned at the collar and cuffs, and must be made of non-flammable materials. Polyester materials are not allowed.
- b. Work boots covering ankles with rubber or composite soles.
- c. Long pants without cuffs to extend over the top of the work boots, and must be made of non-flammable materials. No polyester allowed.
- d. Heavy leather gloves and/or flame retardant gauntlets which must be worn during all handling of a torch, whether operating or not.
- e. OSHA and ANSI/ISEA Z87.1 approved face shields, goggles and/or safety glasses to be worn during torching and any other applicable roofing functions.
- f. OSHA and ANSI approved hard hats.

1.7.4 Wind Conditions

Use side shields with all torching operations when winds are occurring to prevent flame distortion of end burners. Use torch machine equipment with bottom shield plate to prevent flame spread on to roof deck and substrate. When high wind gusts are present, notify the safety officer and cease all use of torching equipment until wind conditions lower and authorization from the safety officer to proceed is received.

1.8 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 counter flashing, per NRCA Details, and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing must immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. 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, shall have a minimum duration of 20 years, and shall apply only to sections of roof removed to the structural deck and replaced with new material.

1.9.1 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 in compliance with ASTM C1289, 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, blisters, splits, tears, 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. Roofing manufacturer shall pay for the repairs specified in this paragraph.
- c. Damage to the roofing system caused a 3-second wind gust having a velocity of 130 mph or less is covered by the warranty.
- d. Upon completion of installation, and acceptance by the Contracting Officer and Roofing System Inspector, the manufacturer must supply the appropriate warranty to the Government.
- e. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the Contracting Officer and Roofing System Engineer of Record.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a 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.

1.10 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance inclusive of ANSI/SPRI ES-1 requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

The roofing system shall be installed according to referenced standards; the Building is not Factory Mutual insured. Factory Mutual standards are used for reference only and compliance with the referenced Code and ASCE-7 is required. Factory Mutual will not be required to test and insure this roofing system.

PART 2 PRODUCTS

2.1 MODIFIED BITUMEN SHEETS MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Materials provided must be suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must comply with ARMA PMBRG98 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

- a. SBS Base Sheet: ASTM D6163, Type I, Grade S, minimum 120 mils thick.
- b. SBS Interply Sheet: ASTM D6163, Type I, Grade S, minimum 120 mils thick.
- c. SBS Cap Sheet (Top Ply): ASTM D6163; Type I, Grade G, minimum 160 mils thick at selvage edge, and as required to provide specified fire safety rating.
- d. Flashing Sheet: ASTM D6163; Type I, Grade G, minimum 160 mils thick glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced, suitable for application method specified for fire safety rating.

2.2 BASE FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Flashing membranes must meet or exceed the properties of the material standards specified for the modified bitumen interply and cap sheet, except that flashing membrane thickness must be as recommended by the membrane manufacturer.

2.3 TORCH-APPLIED MEMBRANE ADHESIVE

Membrane manufacturer's recommended low volatile organic compound (VOC) cold process adhesive for application of the flashing plies.

2.4 MEMBRANE SURFACING

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of light color. Provide modified bitumen membrane manufacturer's recommended field-applied protective coating of light gray color. Aluminized coating that may be used for spot repair of surfacing must comply with ASTM D2824, Type I or III, as recommended by the modified bitumen roof membrane manufacturer.

2.5 PRIMER

ASTM D41/D41M, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.6 FASTENERS AND PLATES

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45 degree tapered corners.

2.6.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fasteners only when approved in writing by the Contracting Officer.

2.6.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

2.7 WALKPADS

Roof walkpads must be fiberglass reinforced, granule-surfaced modified bitumen membrane material, minimum 160 mils thick, compatible with the modified bitumen sheet roofing and as recommended by

the modified bitumen sheet roofing manufacturer. Panels must not exceed 4 foot in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.8 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Insulation must be compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of ASTM C1289 as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.9 MISCELLANEOUS INSTALLATION MATERIALS

2.9.1 Nailers

Nailers shall be #2 or better, and pressure treated with a salt preservative; do not use asphaltic or creosote preservatives. Nominal size shall be 2 feet by 4 inches by 12 inches long.

2.9.2 Exterior Roof Sheathing

Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/C 1177M. Type and thickness: Regular, 1/2 inch thick.

2.9.3 Fasteners

Fasteners shall be stainless steel.

2.9.4 Masonry/Concrete Fasteners

Provide corrosion-resistant, threaded fasteners with a low profile head. Screw fasteners shall be Factory Mutual approved.

2.9.5 Threaded Steel/Wood Fasteners

Corrosion-resistant, self-tapping, self-drilling screw with low profile head. Screw type fasteners shall be Factory Mutual approved.

2.9.6 Wood to Wood Fasteners

Nails shall be number 10, 304 stainless steel ring shank as minimum size. Minimum embedment to base substrate shall be 1 inch.

Screws shall be number 10, 300-series stainless steel wood screw or #14 Phillip pan 300 series stainless steel sheet metal screws as minimum size. Minimum embedment to base substrate shall be 1-inch.

2.9.7 Non-Shrink Grout

Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

PART 3 EXECUTION

3.1 EXAMINATION

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

- a. Drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.
- b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.
- c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 foot when checked with a 10 foot straight edge placed anywhere on the substrate.
- d. Substrate is sloped as indicated to provide positive drainage.
- e. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.
- f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.
- g. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.
- h. Verify all Fire Watch personnel assignments.
- i. 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. Surface-applied nailers are the same thickness as the roof insulation.
- j. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inch.
- k. 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. Insulation is being roofed over on the same day the insulation is installed.
- l. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

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

3.2.2 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 0.75 gallon per 100 sq. ft. or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.2.1 Priming of Concrete Surfaces

After surface dryness requirements have been met, coat concrete surfaces which are to receive membrane materials uniformly with primer.

3.2.2.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.3 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.4 Substrate Preparation

Apply membrane to clean, dry surfaces only. Don not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 REPAIRS

3.3.1 Open Lap/Seam Repair

Insert a hooked device such as a cotter pin puller and lift the open membrane from that adhered. Clean the area between the ply exposed and the loose ply with air blast or flush with primer. Apply a small orifice torch to the open lap area and provide hand pressure with a stainless steel roller from adhered to the cut to achieve adhesion. If the void is such that full adhesion cannot be achieved (ply on ply) with a hand roller, slit the void at the mid-point and follow the above instructions. At these areas that are slit provide a roof system base/foundation coat followed by a layer of new roof coating system fabric covered with a second foundation coat before installation of the roof coating system.

3.3.2 Blister Repair

Provide a hook knife cut at the center point of the blister in both the long and short dimension of the blister. Insert a hooked device such as a cotter pin puller or trowel and lift the open membrane from that adhered. Clean the area between the ply adhered and the loose ply with air blast or

flush with primer. Apply a small orifice torch to the area that is not adhered and provide hand pressure with a stainless steel roller from adhered to the cut to achieve adhesion. If the void is such that full adhesion cannot be achieved ply on ply with a hand roller follow the above instructions and provide a roof system base/foundation coat followed by a layer of new roof coating system fabric covered with a second foundation coat before installation of the roof coating system.

3.4 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt.

3.4.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.

3.4.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing antennas, pipes, ducts, is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing. Do not allow temporary roofing or flashing to remain more than 6 calendar days.

3.4.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

3.4.3 Modified Bitumen Membrane Application

Fully adhere membrane sheets to underlying substrate materials. Provide minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 36 inch. Offset side laps between membrane layers a minimum of 12 inch. Offset end laps between membrane layers a minimum of 36 inch. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.4.3.1 Cap Sheet Installation

Underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. Minimize traffic on newly installed cap sheet membrane. Apply manufacturer-approved coating in area where surfacing is damaged or missing. Minimize traffic on newly installed cap sheet membrane.

3.4.4 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 150 mm (6 inches) on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. Apply matching granules in any areas of adhesive bleed out while the adhesive is still tacky. 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. Metal flashing per SMACNA 1793 guidelines and standards is specified under Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.4.4.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 4 inch beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 4 inch beyond edge of previous ply.

3.4.4.2 Membrane Flashing at Roof Drain

Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, is specified in Section 07 60 00 FLASHING AND SHEET METAL. Extend membrane sheets to edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp membrane sheets and metal roof drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds. Trim stripping must be flush with inside of clamping ring.

3.4.4.3 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are

set on the membrane, adhere walkpad material 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.

3.4.5 Roof Protection

Provide an additional top ply of modified membrane at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Prior to installation, heat the surface of the top ply to sink the granules, then fully adhere the protection ply.

3.4.6 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.5 FLUID APPLIED ROOFING APPLICATION

Refer to Section 07 56 00 FLUID-APPLIED ROOFING.

3.6 CORRECTION OF DEFICIENCIES

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 corrective actions must be 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 modified bitumen roofing system from water intrusion.

3.7.1 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashing can be applied. Remove temporary flashing before applying permanent flashing.

3.7.2 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. 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

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.8.1 Construction Monitoring

During progress of the roof work, Contractor must make visual inspections

as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Materials comply with the specified requirements.
- b. Materials are not installed in adverse weather conditions.
 - (1) All materials are properly stored, handled and protected from moisture or other damages.
- c. Equipment is in working order. Metering devices are accurate.
- d. 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) Membrane heating or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials.
 - (5) The proper number and types of plies are installed, with the specified overlaps.
 - (6) Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.
 - (7) Lap areas of all plies are completely sealed.
 - (8) Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.
 - (9) Installer adheres to specified and detailed application parameters.
 - (10) Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.
 - (11) Temporary protection measures are in place at the end of each work shift.

3.8.1.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of once every 10 to 15 working days during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.8.2 Roof Drain Test

Replace all, above the drain bowl, plastic roof drain elements whether missing or present with new or refurbished steel, cast iron, or Aluminum components (strainer, ring, or, clamping devices).

After completing roofing, but prior to Government acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. 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.

3.9 INFORMATION CARD

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 0.039 inch thick aluminum card for exterior display. Card must be 8 1/2 by 11 inch minimum. Information card must 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. The card must be a minimum size of 8 1/2 by 11 inch. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 53 23

ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING

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.

ASTM INTERNATIONAL (ASTM)

ASTM D4637/D4637M (2014; E 2014) EPDM Sheet Used in Single-Ply Roof Membrane

ASTM D6369 (1999; R 2006) Design of Standard Flashing Details for EPDM Roof Membranes

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/>

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA RoofMan (2011 thru 2014) The NRCA Roofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI RD-1 (2009) Performance Standard for Retrofit Drains

1.2 SUMMARY

Fully adhered EPDM roof membrane system applied over concrete roof deck substrate. Scope is limited to an area described on the contract documents including one area of existing EPDM roof and installation of a new roof drain. All work associated with the existing EPDM roofing must comply with the current roof warranty. Work in this area requires coordination with DCG Roofing Solutions, Inc., 1285 Rand Road, Des Plaines, IL 60016.

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

Roof Plan Drawing

Slopes and Drain Locations

SD-03 Product Data

Cement

EPDM Sheet; G

Seam Tape

Bonding Adhesive

Lap Splice Adhesive

Water Cutoff Mastic/Water Block

Lap Cleaner, Lap Sealant, and Edge Treatment

Flashings

Application Method

Fasteners and Plates

Roof Insulation

Sample warranty certificate; G

Submit all data required together with requirements of this section. Include a written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-07 Certificates

Qualification of Manufacturer

Certify that the manufacturer of the roof membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Fire Resistance classification; G

Submit the roof system assembly fire rating classification listings.

SD-08 Manufacturer's Instructions

Application; G

Adhesive Seams / Lap Splices

Primer

Fasteners

Cold Weather Installation; G

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's printed instructions and the specified requirements.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

Include copies of Material Safety Data Sheets for maintenance/repair materials.

1.3.1 Shop Drawings

Roof plan drawing depicting area of roof removal and renovation as applicable. Provide all slopes and drain locations.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

EPDM sheet roofing membrane manufacturer must have at least 5 years experience in manufacturing EPDM roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the roof membrane manufacturer and must have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

- a. Drawings, specifications and submittals related to the roof work;
- b. Roof system components installation;
- c. Procedure for the roof manufacturer's technical representative's onsite

inspection and acceptance of the 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;

- 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 plan for the roof system installation;
- f. Safety requirements.

Coordinate prerooting conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, other trades interfacing with the roof work, and 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.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels must bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.5.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's printed instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers and other liquid materials above 60 degrees F. Insulated hot boxes or other enclosed warming devices must be required in cold weather. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each days work.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure or moisture. Remove contaminated materials from the site. When hazardous materials are involved, adhere to the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install EPDM sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface, or when condensation develops on surfaces during application. Unless recommended otherwise by the EPDM sheet manufacturer and approved by the Contracting Officer, do not install EPDM sheet when air temperature is below 40 degrees F or within 5 degrees F of the dewpoint. Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 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 are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.8 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to existing 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.

1.8.1 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. The warranty must run directly to the Government and commence 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, shrinks to the point of bridging or tenting membrane at transitions, 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 must be the responsibility of the roof membrane manufacturer. The roof membrane manufacturer is responsible for all costs associated with the repair or replacement work.
- 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.

1.8.2 Roofing System Installer Warranty

The roof system installer must warrant for a 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.

1.8.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplish 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.

1.9 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA RoofMan, membrane manufacturer published recommendations and details, ASTM D6369, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

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. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 EPDM Sheet

Ethylene Propylene Diene Terpolymer (EPDM), ASTM D4637/D4637M, fully adhered to match existing membrane.

2.1.2 Seam Tape

Double-sided synthetic rubber tape, minimum 0.03 inch thick, minimum 3 inch wide. The roof membrane manufacturer must supply seam tape recommended by the manufacturer's printed data for forming watertight bond of EPDM sheet materials to each other for the application specified and conditions encountered. 6 inch wide tape is required for seam seals along lines of mechanical attachment of membrane.

2.1.3 Lap Splice Adhesive

Low volatile organic compound (VOC) synthetic rubber adhesive as supplied by roof membrane manufacturer and recommended by the manufacturer's printed data for forming watertight bond of EPDM sheet membrane materials to each other.

2.1.4 Bonding Adhesive

Low volatile organic compound (VOC) adhesive as supplied by roof membrane manufacturer and recommended by the manufacturer's printed data for bonding EPDM membrane materials to insulation, wood, metal, concrete or other substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.5 Lap Cleaner, Lap Sealant, and Edge Treatment

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.6 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.7 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended by the roof membrane manufacturer and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. As supplied and warranted for the substrate type(s) by EPDM sheet manufacturer and recommended by EPDM sheet manufacturer's printed data.

2.1.7.1 Stress Plates for Fasteners

Flat corrosion-resistant round stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 2 inch in diameter. Provide pre-formed discs to prevent dishing or cupping.

2.1.7.2 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors suitable for intended attachment purpose and as recommended by the roof membrane manufacturer.

2.1.7.3 Powder-Driven Fasteners

Powder-driven fasteners may be used only when approved in writing.

2.1.7.4 Metal Disks

Provide flat metal disks of minimum 1 inch in diameter. Metal disks must be of nonferrous material compatible with the nails or fasteners.

2.1.8 Wood Products

Do not allow fire retardant treated materials be in contact with EPDM membrane or EPDM accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.1.9 Membrane Liner

Self-adhering EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the roof membrane manufacturer and the Contracting Officer.

2.2 FLASHING CEMENT

Provide a self-vulcanizing butyl compound flashing cement for splicing laps and for flashings workable at 20 degrees F. Obtain a recommendation for such flashing cement from the roofing membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

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

- a. Drain is in place.
- b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.
- c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10 foot straight edge placed anywhere on the substrate.
- d. Substrate is sloped to provide positive drainage.
- e. Avoid contact of EPDM materials with fire retardant treated wood, except as approved by the roof membrane manufacturer and Contracting Officer.

3.2 APPLICATION

Apply entire EPDM sheet utilizing fully adhered application methods. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer.

3.2.1 Special Precautions

- a. Do not dilute coatings or sealants unless specifically recommended by the materials manufacturer's printed application instructions. Do not thin liquid materials with cleaners used for cleaning EPDM 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 elastomeric 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 EPDM 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.

3.2.2 EPDM Sheet Roofing

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Unroll EPDM sheet roofing in position without stretching membrane. Inspect for holes. Remove sections of EPDM sheet roofing that are damaged. Allow sheets to relax minimum 30 minutes before seaming. Lap sheets as specified, to shed water, and as recommended by the roof membrane manufacturer's published installation instructions for the application required but not less than 3 inch in any case.

3.2.3 Application Method

3.2.3.1 Fully 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. 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 full, continuous bonding of sheet to substrate. Form field lap splices or seams as specified. Check all seams and ensure full lap seal. Apply lap sealant to all adhesive formed seams and all cut edges of reinforced membrane materials.

3.2.4 Adhesive Seams / Lap Splices

Use only field-applied adhesive formed seams where approved by the membrane manufacturer and the Contracting Officer. Do not use adhesive formed seams for field of roof membrane seaming, except as approved by the membrane manufacturer and the Contracting Officer. Thoroughly and completely clean mating surfaces of materials throughout the lap area. Remove all dirt, dust, and contaminants and allow to dry.

Apply primer as recommended by the membrane manufacturer. Apply splice adhesive with a 3 inch to 4 inch wide, 1/2 inch thick, solvent-resistant brush in a smooth, even coat with long brush strokes. Bleed out brush marks. Do not apply adhesive in a circular motion. Simultaneously apply adhesive to both mating surfaces in an approximate 0.025 to 0.030 inch wet film thickness, or other thickness as recommended by the roof membrane manufacturer's printed instructions.

Allow the splice adhesive to set-up in accordance with membrane

manufacturer's printed instructions. Perform manufacturer recommended field check to test for adhesive readiness prior to closing seam. Apply a 1/8 inch to 1/4 inch bead of in-seam sealant approximately 1/2 inch from the inside edge of the lower membrane sheet prior to closing the seam. Ensure the in-seam sealant does not extend onto the splice adhesive. Maintain the full adhered seam width required. Roll the top membrane onto the mating surface. Roll the seam area with a 2 inch to 3 inch wide, smooth silicone or steel hand roller. A minimum of 2 hours after joining sheets and when the lap edge is dry, clean the lap edge with membrane manufacturer's recommended cleaner and apply a 1/4 inch to 3/8 inch bead of lap sealant centered on the seam edge. With a feathering tool, immediately feather the lap sealant to completely cover the splice edge, leaving a mound of sealant over the seam edge. Apply lap sealant to all adhesive formed seams.

3.3 FLASHINGS

3.3.1 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 must conform to ANSI/SPRI RD-1.

3.3.2 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.

3.4 CORRECTION OF DEFICIENCIES

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 corrective actions must be as directed by the Contracting Officer.

3.5 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.6 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.

3.6.1 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. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.6.2 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.

3.6.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. 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.

3.7 FIELD QUALITY CONTROL

3.7.1 Construction Monitoring

During progress of the roof work, Contractor must 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. Materials comply with the specified requirements.
 4. All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.
 5. Membrane is allowed to relax prior to seaming. Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required.
 6. Membrane is properly overlapped.
 7. Membrane seaming is as specified and seams are hand rolled to

ensure full adhesion and bond width. All seams are checked at the end of each work day.

8. Applied membrane is inspected and repaired as necessary prior to ballast installation.
9. Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths.
10. Installer adheres to specified and detailed application parameters.
11. Associated flashings are installed in a timely manner in accord with the specified requirements.
12. Temporary protection measures are in place at the end of each work shift.

3.7.2 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times once per week during the installation for purposes of reviewing materials installation practices and adequacy of work in place. After each inspection, submit a report signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.7.3 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. Retrofit roof drains must conform to ANSI/SPRI RD-1. 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.

3.8 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.

3.9 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a photoengraved 0.032 inch thick aluminum card for exterior display. Card must be 8-1/2 by 11 inch minimum. Information card must 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.

-- End of Section --

SECTION 07 56 00

FLUID-APPLIED ROOFING

10/12

PART 1 GENERAL

1.1 SUMMARY

Provide Mesh Reinforced Elastomeric Coating (MREC) roofing system complete as specified over existing modified bitumen roof membrane surface after patching and repairs of existing roof and replacement of roof have been completed and accepted by the Government.

Acrylic coatings containing or modified with polymers incorporating non-acrylic monomers such as (but not limited to) styrene, vinyl or other ingredients are not allowed. Only 100 percent acrylic polymers shall be used. Materials such as cementitious, ceramic-filled or asphalt modified coatings, moisture-cured urethanes, Kraton-based rubbers, Hypalons and butyls are not considered acceptable substitutes for materials specified herein.

Coatings found to contain banned ingredients shall be removed from the property or shall be resurfaced with a complete roof system that meets the roofing 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.

ASTM INTERNATIONAL (ASTM)

ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM D 117	(2002) Standard Guide for Sampling, Test Methods, Specifications and Guide for Electrical Insulating Oils of Petroleum Origin
ASTM D 1777	(1996; R 2007) Thickness of Textile Materials
ASTM D 3787	(2007) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 412	(2006ae2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 6083	(05e1) Standard Specification for Liquid Applied Acrylic Coating Used in Roofing

ASTM D 638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D 7281	(2007) Standard Test Method for Determining Water Migration Resistance Through Roof Membranes
ASTM E 108	(2010a) Fire Tests of Roof Coverings
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 29	(2010) Standard Practice for Determining Algal Resistance of Plastic Films

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
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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements
ISO 14001	(2004) Environmental Management

1.3 SEQUENCING AND SCHEDULING

Specification subparagraph text.

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

Construction Grade Caulk; G
Basecoat and Intermediate Coatings; G
Finish Coat; G
Reinforcing Fabric; G
Cant Strips; G
Corrosion Resistant Primer; G
Traffic Coating; G
Biodegradable Cleaner; G

SD-07 Certificates

Manufacturer Qualifications; G
Installer Qualifications
Qualification of Inspector

SD-08 Manufacturer's Instructions

Manufacturer's written instructions

SD-09 Manufacturer's Field Reports

Field tests; G
Manufacturer's Inspection report; G

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer Qualifications

Manufacturer must be ISO 9001 and ISO 14001 certified.

Manufacturer of the MREC system shall have a proven 15-year track record of successful installations using advanced elastomeric acrylic technology in the roofing industry.

Manufacturer's written instructions for installation, including details, shall be provided.

1.5.2 Installer Qualifications

Installer shall be approved by the coatings manufacturer, and shall have a minimum of five years experience in the application of acrylic elastomeric roof coatings.

Proof of this qualification shall be provided in written form from the manufacturer of the roofing system. A signed certificate from the Manufacturer stating that the Contractor is an approved installer of the Manufacturer's Complete Fluid Applied Roofing System and that each member of the installation crew has been trained in the system's proper installation and is certified by the Manufacturer's Technical Representative. The names of the certified installers shall be submitted to Contracting Officer and only employees that are certified installers shall be allowed on the project.

Contractor shall provide a list of five project references, including contact name and telephone numbers.

An Approved Applicator (as designated by manufacturer) shall be on site during all applications of any manufacturer's products.

Contractor shall be responsible to protect all substrates, insulation, recovery board and coating from pollutants that may act as a bond-breaker between the various applications of coating. These pollutants include (but not limited to) foot traffic residue, metal shavings, tire tracks, markings caused by hoses and electrical cords, insulation adhesive, sealants, and cementitious materials. All pollutants shall be removed prior to the application of any coatings.

1.5.3 Product Standards

The acrylic system shall be approved and listed by Factory Mutual as an

acceptable Class I-4470 Roofing System over existing roof substrates.

Container labels shall include this information or the container shall be rejected at the jobsite. Manufacturer's name, product name, type and class of material. Factory Mutual logo, batch or lot number, mixing and application instructions, and precautions.

1.5.4 Codes and Standards

The Contractor shall be thoroughly familiar with all codes, regulations, and standards governing the specified work. Any contradiction between the manufacturer's requirements and these specifications shall be brought to the attention of the manufacturer and the Contracting Officer.

1.5.5 Deviations

There shall not be any deviations from these specifications unless the deviation is submitted in writing per the General Conditions. The request for deviation shall have a letter from the roofing manufacturer technical department approving the details of the deviation.

1.5.6 Manufacturer's Technical Representative

An employee of the roofing material manufacturer shall be on site at least once every 7-calendar days during the on-site Work. Upon request, the technical representative shall provide a written inspection report during each site visit and submit the reports to the Contracting Officer. The manufacturer's Representative shall approve the application process at specific stages before the Contractor may continue including: Pre-bid inspection, start-up inspection, at the completion of the foundation coat and fabric components; and completed finish coat inspection.

1.5.7 Qualification of Inspector

Contractor shall hire full-time third-party Roofing Inspectors for the life of this Contract who will be on site daily during roofing operations to perform Inspection Duties required for proper repair of roof. Inspectors shall supply names, locations, and client contract information of 5 projects of similar size and scope that the Inspectors have witnessed using the roofing products specified. Qualifications for Inspectors shall include one of the following:

a. Roofing Inspector shall be approved, authorized or licensed in writing by the Roofing Consultants Institute as either a Registered Roofing Consultant, Certified Roofing Observer, or Registered Roofing Observer. Inspector shall have a minimum 10 years experience.

b. Roofing Inspector must be licensed professional architect or engineer demonstrating 10 years continuous specialized experience in design, investigation, testing, and consulting services related to roofing, waterproofing, and building envelope systems for new and existing structures.

Inspectors shall have a thorough knowledge of roofing details, flashing and systems employing roofing system of existing roof. Roofing inspection shall be a full-time occupation Roofing Inspector. If testing is required, Roof Consultant shall be appropriately trained, certified, and licensed in the testing procedure specified.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery of Materials

Materials shall be delivered to the jobsite in manufacturer's original, sealed containers with labels legible and intact.

a. Deliver materials bearing the following information:

- 1) Name of manufacturer.
- 2) Name of contents and products code.
- 3) Net volume of contents.
- 4) Lot or batch number.
- 5) VOC content.
- 6) Storage temperature limits.
- 7) Shelf life expiration date.
- 8) Mixing instructions and proportions of contents.
- 9) Safety information and instructions.

1.6.2 Storage of Materials

Materials shall be stored in an area specifically designated for that purpose, in accordance with manufacturer's recommendations, where temperatures shall not be less than 50 degree F or higher than 100 degree F.

1.6.3 Material Handling

Materials shall be handled, stored and installed per manufacturer's instructions and all applicable safety regulatory requirements.

1.6.4 Damaged Materials

Contaminated, damaged or unsealed materials, or materials not conforming to the specifications, shall be rejected. Rejected materials shall be immediately removed from the jobsite and replaced at no additional cost to the Government.

Materials that have been installed and damaged prior to issuance of warranty shall be rejected and removed from the jobsite. This includes materials not protected from unprotected foot traffic, materials that were unprotected and used as a staging platform or storage area, materials that have been polluted with dirt, debris, metal shavings and other roofing materials, and or materials damaged by water intrusion.

1.7 PROJECT CONDITIONS

Install all materials in strict accordance with manufacturer's published safety requirements and weather precautions.

Do not apply materials over dirt, oil, grease, or other pollutants (this includes foot traffic or markings caused hoses, electrical cords, flexible conduits on roof, or tires). All dirt or markings shall be removed prior to the installation of the various applications of coating used to produce the liquid applied roof system.

Do not apply elastomeric acrylic coating system components when the Ambient temperature is below 50 degree F or above 110 Degree F, if any surface moisture is present, when the dew point is within 5 degree F of the surface temperature or when there is a possibility of temperatures falling below 32

degree F within a 24 hour period.

Do not apply MREC system components if weather conditions will not permit complete cure before rain, dew, fog or freezing temperatures occur.

Do not spray-apply if the wind velocity exceeds 10 mph without taking precautions to eliminate warranty.

Take all measures necessary to protect unrelated surfaces from coating overspray or spillage.

Contractor is responsible for any adverse conditions, which may result from applying coatings while the weather is rising during the morning hours, which might result in moisture being pulled upwards from the deck, which can result in vapor pockets forming.

1.8 WARRANTY

Contractor shall furnish to the Contracting Officer, the following:

a. Written guaranty on the Mesh Reinforced Elastomeric Coating (MREC) Fluid Applied Roofing System for a 2-year period after Project Acceptance Date by the Government. This shall be a non-prorated, full-value, no-dollar-limit, material-and-labor guaranty for the roofing system and shall provide the following at no additional cost to the Government:

1) Repair of roofing flashing, pitch pockets, drains, curbs, etc., as necessary to seal and repair all leaks which are attributable to faulty materials and/or workmanship.

2) Repair or replacement of damage to the building and/or its finishes, equipment and/or furnishings, when occasioned by such leaks; and

3) Inspection of the roofing by the Contractor and the roofing manufacturer's technical representative together with the COTR and/or a COTR representative, of the roofing and flashing, on or about the first and second anniversaries of the Project Acceptance Date, and repair or replacement of roofing as necessary to correct any deficiencies in workmanship or materials, such as by eliminating blisters exceeding six inch in any dimension or re-adhering open seams. Such correction work shall be done in a manner, which will preserve the integrity of the complete roofing system.

b. The liquid applied roofing system manufacturer shall submit to the contracting officer, via the Contractor, made out to the Government a 10-year Leak Free, Material and Labor, Roofing System Warranty. The warranty shall cover both material and workmanship and shall provide that in the event of failure due to normal weathering and wind conditions during the remainder of the warranty period (the third through thirtieth years after project acceptance) the liquid applied roofing system manufacturer will make repairs as necessary to maintain the roof in a watertight condition at no cost to the Government. The warranty shall contain a certification by the manufacturer that the complete roofing system has been installed in accordance with the manufacturer's instructions and that the Government has been provided maintenance instructions for the roof. The warranty shall contain no

exclusions for materials furnished by the manufacturer. The warranty shall include all waterproofing details incorporated on the parapet walls and other areas, flashings, and sealants. The Surety shall not be held liable beyond two years from the Project Acceptance Date.

PART 2 PRODUCTS

2.1 MANUFACTURERS

ISO 9001 and ISO 14001 Manufacturer that meets all of the required requirements of this specification.

2.2 SYSTEM DESCRIPTION

Over existing Modified Bitumen Roofing: A seamless, 52 mil (minimum (not minimum average - dry) liquid-applied acrylic membrane system designed for application over existing Modified Bitumen Roofing meeting FM 4470 Approval. Basis-of-Design is the Hydro-Stop PremiumCoat System consisting of UniBase Primer, PremiumCoat Foundation Coat, PremiumCoat Fabric, and PremiumCoat Finish Coat.

2.3 COMPONENTS

2.3.1 Construction Grade Caulk

Single package polyurethane sealant, as approved by roofing coating manufacturer for use in filling cracks, splits or voids, and for sealing reglet counter flashings.

2.3.2 Basecoat and Intermediate Coatings

Water-based, high solids elastomeric acrylic coating shall be internally plasticized to provide a permanently flexible, weather-resistant base coat and intermediate. It shall be tested as part of a FM 4470 roof assembly.

a. Color: Color other than white as provided by manufacturer.

2.3.3 Finish Coat

Water-based, high solids elastomeric acrylic coating shall be internally plasticized to provide a permanently flexible, weather-resistant base coat and intermediate. It shall be tested as part of a FM 4470 roof assembly.

a. Color: The base application(s) of finish coat shall be tan and the top application(s) shall be gray, or color approved by Contracting Officer.

2.3.4 Roof System's Material Properties

Minimal dry mil thickness of 52 mils with polyester fabric:

Property	Test	Result
Leakage Resistance	ASTM D 7281	Passed 7-day submersion under water with pressure cycling
Tensile Strength (cured)	ASTM D 412	Greater than 2000 psi

Property	Test	Result
Elongation	ASTM D 638 or ASTM D 412	Greater than 300%; 50% with reinforcing fabric
Algae Resistance	ASTM G 29	No growth supported
Weathering	ASTM G 26	No effect after 3000 hours
Salt Spray Test	ASTM B 117	No effect
Moisture Vapor	ASTM E 96/E 96M	3 Perms
Fire Rating	ASTM E 108 and FM 4470	Class A
Fluid Applied Acrylic	ASTM D 6083	Approved
Windstorm Pull Test	FM 4470	Class I-735 lightweight concrete
Hail (severe impact) Resistance	FM 4470	Passed over rigid foam
Foot Traffic Resistance	FM 4470	Passed
Susceptibility to Leakage	FM 4470	Passed 7-day test and pressure cycle test

2.3.5 Reinforcing Fabric

This material shall be non-woven 100 percent polyester, stitch bonded, and heat set fabric. The fabric shall bear the Factory Mutual label (FM) printed on the fabric surface. The fabric shall meet these following characteristics:

- a. Weight: 3 oz/sq. yd.
- b. Tensile Strength Warp 74 lbs per ASTM D 5034.
- c. Tensile Strength Fill 45 lbs.
- d. Elongation at Break Warp 21.3 percent per ASTM D 5034.
- e. Elongation at Break Fill 51.3 percent.
- f. Ball Burst 111 lbs per ASTM D 3787.
- g. Trapezoid Warp 13.5 lbs per ASTM D 117.
- h. Trapezoid Fill 24.2 lbs.
- i. Thickness 0.018 inches per ASTM D 1777.

2.3.6 Roof Penetrations

Protective Cement Surface around Kitchen Vents and Grease Traps (where applicable): Provide Reinforced cement and polymer acrylic bonding agent slurry (example: Hydro-Stop Barrier Guard).

- a. The slurry consist of one part polymer acrylic bonding agent, one part water, three parts Type I/II Portland Cement.

b. Slurry and polyester fabric is applied to the surface of the liquid applied roof system on all identified areas.

2.3.7 Cant Strips

Cant strips, where applicable, can be made from EPS, polyisocyanurate, or perlite.

2.3.8 Corrosion Resistant Primer

Single component, premium quality exterior acrylic latex primer, as approved by the manufacture. Example of the primer is Hydro-Stable Rust Primer. For corrosion protection, flash rust resistance and enhanced adhesion over all metal surfaces metal surfaces.

2.3.9 Traffic Coating

Provide traffic resistant water-based coating where applicable.

Material Properties:

- a. Density: 11.91 lb/gal 1427.13 gm/lt
- b. Volume Solids: 55.73 percent plus 2 percent.
- c. Weight Solids: 70.14 percent plus 2 percent.
- d. VOC (calculated): > 72 g/L
- e. Elongation at 700F > 600 percent.

2.3.10 Biodegradable Cleaner

All cleaners shall be biodegradable and shall be mixed at rate of one part cleaner to nine parts water. Example of the cleaner agent is Hydro-Stop UCC Cleaner.

Material Properties:

- a. Biodegradable: Allows proper cleaning of substrates where washing with hazardous cleaning products would not be permitted prior to (re)coating.
- b. Open Dry Time: Removes dirt, pollutants and other contamination build-up even if the product dries prior to rinsing.
- c. Environmentally Safe: Will not harm ground vegetation, water collection ponds, septic tanks or treatment plants even in its concentrated form, nor will accidental ingestion by animal life cause adverse side effects.
- d. Agency Approvals: Meets all the requirements of U.S.D.A. and FDA standards, and is also OSHA compliant.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly prepared.

- a. Verify substrate surfaces are durable, free of frozen matter, dampness, loose particles, cracks, pits, projections, or foreign matter detrimental to adhesion or application of waterproofing system.
- b. Verify that substrate surfaces are smooth and not detrimental to full contact bond of waterproofing materials.
- c. Verify items that penetrate surfaces to receive waterproofing are securely installed.
- d. Verify that substrate areas are adequately supported and firmly fastened in place.
- e. Verify that roof deck has a minimum slope of 0.25 inch/foot.
- f. Verify that roof does not have ponding water areas.
- g. Verify that all attached vertical walls are properly waterproofed.

3.2 PREPARATION

All surfaces shall be clean and dry, and free of any dirt, dust, gravel, oil, surface chemicals or other contaminants that may interfere with optimum adhesion.

All metal to be covered with insulation that has any sign of rust shall be wire brushed and then coated with Stable Rust primer (5.0 mils dry).

All metal to be directly encapsulated with the liquid applied roof system shall be coated with Stable Rust primer (5.0 mils dry).

Any damaged or structurally unsound metal, lumber or concrete shall be repaired or replaced.

Surface Primer as a basis of design provide Uni-Base primer or equivalent required by system manufacturer for all surfaces to receive Mesh Reinforced Elastomeric Coating.

Remove all paint and loose material from the vertical wall surface to the minimum height shown on the drawings.

- a. Protect adjacent surfaces not designated to receive waterproofing. As a minimum, clean and prepare surfaces to receive waterproofing by removing all loose and flaking particles, grease and laitance with the use of a stiff bristle push broom and or washing. Take care not to inject water into the substrate during washing. Where required, provide additional drying time after the cleaning process. Please consult the roofing manufacturer's technical representative for additional advice on cleaning various roofing substrates.
- b. Make all necessary repairs to existing substrate. Contact manufacturer's technical representative for assistance.

c. Do not apply waterproofing to surfaces unacceptable to manufacturer.

3.3 INSTALLATION

3.3.1 Foundation and Intermediate Coat and Fabric Components

Consists of one coat of foundation coat applied to the substrate, one ply of the polyester fabric (sizes vary) laid into the wet foundation coat, and finally a second coat of foundation (intermediate) coat saturating the fabric from above. Care shall be given to ensure that adjacent runs of fabric are overlapped a minimum of 4 inches. Foundation and intermediate coats are applied over a smooth surface at a total rate of 2.5 gallons per 100 square feet of fabric (this application rate is over a smooth and non-porous substrate, coverage rate will vary depending on surface texture and porosity). Foundation coat shall only be applied with the use of approved roof brushes. Rolling and spraying of the foundation and intermediate coat is forbidden. The dry mil thickness of membrane produced with the foundation and intermediate coat and polyester fabric shall be a minimum thickness of 30 mils (dry).

3.3.2 Protection of Foundation Coat and Polyester Fabric Membrane

It is the Contractor's responsibility to protect the membrane produced by the foundation and intermediate coat and polyester fabric from damages. All membranes that are damaged shall be rejected and removed from the job site. Damages shall include, but not limited to, coatings being marked with pollutants that may act as a bond-breaker between the various applications of coating. These pollutants include (but not limited to) foot traffic residue, metal shavings, tire tracks, markings caused by hoses and electrical chords, insulation adhesive, sealants, and cementitious materials. All pollutants shall be removed prior to the application of any coatings. Walking on the coating while the coating and fabric is wet is forbidden. Walking on the membrane with shoes that are not covered with protective shoe coverings (example: painter's booties) is forbidden. Using the membrane as a staging platform without laying plywood on the surface to protect the membrane is forbidden. Allowing pools of water to sit on the coating during the first seven days (pools of water must be brushed off each morning).

3.3.3 Encapsulation of Roof Perimeter

Using 12-inch fabric and the foundation components (described above), waterproof entire roof perimeter. Continue waterproofing up vertical surfaces and onto deck a minimum of 6 inches in each direction.

3.3.4 Encapsulation of Roof Penetrations

Using 12 inch fabric and the foundation components seal items projecting through waterproofing material watertight. Waterproof up penetrations a minimum of 6 inch.

3.3.5 Encapsulation of Roof Field

Using 40 inch (1. m) fabric and the foundation components (as described above) seal the entire roof field. Overlap adjacent runs of fabric 4 inches minimum.

3.3.6 Encapsulation of Walls and Curbs

Using 40 inch or 20 inch fabric and the foundation components (as described above) seal all identified wall areas and all curbs (vertical and horizontal surfaces). Overlap adjacent runs of fabric 4 inches minimum.

3.4 INSTALLATION OF FINISH COAT

3.4.1 Finish Coat Component

Apply the finish coat. Each application must be applied at a wet mil thickness of 12 mils. Each application shall be applied at rate of 1.5 gallon per 200 square feet per application. The total application rate shall be 1.5 gallons per 50 square feet. The total dry mil thickness shall be 15 mils. The color of the finish coat shall be tan followed by gray or as approved by the COTR. Allow the first application to dry for eight hours prior to the application of the second application. The total finish coat dry thickness shall be a minimum of 22 mils dry (.0220 inches). Monitor these two coats for 5 days, sweeping off birdbaths to allow for full cure.

3.4.2 Protection of Finish Coat

It is the Contractor's responsibility to protect the finish coat from damages. All finish coat that is damaged shall be rejected and removed from the job site. Damages shall include (but not limited to) coatings being marked with pollutants that may act as a bond-breaker between the various applications of coating. These pollutants include (but not limited to) foot traffic residue, metal shavings, tire tracks, markings caused by hoses and electrical chords, insulation adhesive, sealants, and cementitious materials. All pollutants shall be removed prior to the application of any coatings. Furthermore, walking on the coating while the coating is wet is forbidden. Walking on the coating with shoes that are not covered with protective coverings (example: painter's booties) is forbidden. Using the coating or the coating membrane system as a staging platform without laying plywood on the surface to protect the membrane is forbidden. Allowing pools of water to sit on the coating during the first seven days (pools of water must be brushed off each morning).

3.5 ROOF SYSTEM MIL THICKNESS

Roof System shall be installed to a minimum 52 mil total cured thickness.

Dry mil thickness test: The coating manufacturer's representative, Contracting Officer and Contractor shall make a final inspection to determine the dry film thickness of the liquid-applied acrylic membrane and to verify that the system meets the manufacturer's requirements for warranty. The Contractor shall notify all interested parties in advance of scheduled inspection. The Government shall require three dry mil sample cuts of 2-inch by 1-inch and the Government shall select the three areas where the samples shall be removed. Contractor shall immediately repair the sample areas with the complete Liquid Applied Roof System using a 6-inch by 6-inch polyester fabric. The samples shall be cut in half and the Government shall be given half of each sample. The samples shall be measured with a micrometer to determine that the mil thickness of the roof system shall be a minimum of 55 mils. If the mil thickness is not correct, the Contractor shall apply additional finish coating.

3.6 INSTALLATION OF PROTECTIVE CEMENT SURFACE

Install protective Cement Surface Systems at areas applicable, or where grease and oil may occur. These areas are most common around vents. In addition, install protective Cement Surface Systems to correct areas of ponding water.

Apply painter's tape to the surface of the roof system around all kitchen vents and grease trap areas when applicable. The tape shall be set a minimum of three feet from the curbs supporting the vents.

Remove all pollutants from the surface of the roof system. Protect the roof surface while mixing the cement slurry.

Mix the three gallons of Portland cement, one gallon of water and one gallon of Barrier Guard (acrylic bonding agent). Mix the slurry and apply the slurry to roof surface and immediately brush in the polyester fabric. Once the fabric is brushed into the slurry, immediately apply a second application of the slurry.

Wait three to six hours and apply a third application of cement slurry. Remove painter's tape.

3.7 INSTALLATION OF PROTECTIVE TRAFFIC COAT

Provide protective Traffic Coat at areas where daily foot traffic occurs and at the top and bottom of all access ladders, hatches, and stairs.

Apply painter's tape to the surface of the roof system to designate walkways. The tape shall be set a minimum of three feet apart so as to produce a three-foot wide footpath.

Remove all pollutants from the surface of the roof system. Protect the roof surface while mixing the Traffic Coat. Mix the Traffic Coat with an electric drill for a minimum of three minutes. Apply one coat of Traffic Coat at a rate of 100 square feet per gallon. Wait three to six hours and apply a second application of Traffic Coat. Remove painter's tape.

3.8 CLEAN UP

Maintain work and work areas in a clean, safe condition at all times during coating installation. Remove excess materials, trash and debris from the jobsite daily.

At the completion of the project, clean area of any spills and containers, and clean up all roofing debris, leaving jobsite in a clean and orderly condition.

As a condition of the project's completion and acceptance, deliver to the Government a copy of the full executed, specified warranty from the coating manufacturer, following individual warranty guidelines.

3.9 PROTECTION

Protect installed products until completion of project. Touch-up, repair or replace damaged products before Substantial Completion.

3.10 FIELD QUALITY CONTROL

Perform field tests in the presence of the Roof Inspector and Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.10.1 Construction Monitoring

During progress of the roof work, Contractor must make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Materials comply with the specified requirements.
- b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

- c. Equipment is in working order. Metering devices are accurate.
- d. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

3.10.1.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of once every 10 to 15 working days during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.11 INFORMATION CARD

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 0.039 inch thick aluminum card for exterior display. Card must be 8 1/2 by 11 inch minimum. Information card must 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. The card must be a minimum size of 8 1/2 by 11 inch. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- 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 ES-1 (2003) Wind Design Standard for Edge
Systems Used with Low Slope Roofing Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2008) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A167 (2011) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B221 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

ASTM B32 (2008) Standard Specification for Solder
Metal

ASTM B370 (2012) Standard Specification for Copper
Sheet and Strip for Building Construction

ASTM D1784 (2011) Standard Specification for Rigid
Poly(Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly(Vinyl Chloride) (CPVC)
Compounds

ASTM D41/D41M (2011) Asphalt Primer Used in Roofing,
Dampproofing, and Waterproofing

ASTM D4586 (2007) Asphalt Roof Cement, Asbestos-Free

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

SD-02 Shop Drawings

Gravel stops and fascias; G
Counterflashing; G
Reglets; GCopings; G
Drip edge; G
flashing at roof penetrations; G

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. 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: 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 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.5 Aluminum Alloy Sheet and Plate

ASTM B209; form alloy, and temper appropriate for use.

2.1.5.1 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 white or bone white to match existing.

2.1.6 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.1.7 Solder

ASTM B32, 95-5 tin-antimony.

2.1.8 Polyvinyl Chloride Reglet

ASTM D1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.9 Bituminous Plastic Cement

ASTM D4586, Type I.

2.1.10 Asphalt Primer

ASTM D41/D41M.

2.1.11 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 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.

3.1.2 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.

3.1.3 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. Prein cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inch or less in thickness.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inch.

3.1.5.3 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.

3.1.5.4 Standing Seams

Not less than one inch high, double locked without solder.

3.1.5.5 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin 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.

3.1.6.1 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.

3.1.7 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.

3.1.7.1 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.

3.1.7.2 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.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 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.

3.1.8.2 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 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.

3.1.10 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. 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 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. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.11 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.

3.1.11.1 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.

3.1.11.2 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.

3.1.12 Gravel Stops and Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inch onto roofing. Comply with ANSI/SPRI ES-1. 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.

3.1.12.1 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 inch maximum 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.

3.1.12.2 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.

3.1.13 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. Comply with ANSI/SPRI ES-1. Apply directly on the 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 fasteners spaced not more than 10 inch on center along upper edge.

3.1.14 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.

3.1.15 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.16 Single Pipe Vents

See Table I, footnote (d). Provide 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 of 8 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.

3.1.17 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.

3.1.18 Copings

Provide coping using pre-painted aluminum complying with ANSI/SPRI ES-1. Terminate outer edges in edge strips. Install with sealed cover plate 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	Stainless Steel, Inch
<hr/>	
Flashings:	
Base018
Cap (Counter-flashing)	.015
Sheets, smooth018
Pitch Pocket018
and accessories	

TABLE II. SHEET METAL JOINTS
TYPE OF JOINT

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Remarks
Sheet, smooth	Butt with 1/4 inch space	
Pitch Pocket and accessories		1 inch flat-locked soldered & sealed.

-- End of Section --

SECTION 07 82 00

REFRACTORY PANELS

01/15

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 CIVIL ENGINEERS (ASCE)

ASCE 7 (2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C165 (2007; R 2012) Standard Test Method for Measuring Compressive Properties of Thermal Insulations

ASTM C177 (2013) Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

ASTM C182-88 (2009) Standard Test Method for Thermal Conductivity of Insulating Firebrick

ASTM C24-09 Standard Test Method for Pyrometric Cone Equivalent (PCE) of Fireclay and High Alumina Refractory Materials

ASTM C447-03 (2010) Standard Practice for Estimating the Maximum Use Temperature of Thermal Insulations

UNIFIED FACILITIES CRITERIA (UFC)

UFC 4-179-01 (2004) Design: Navy Firefighting School Facilities

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

Refractory panel layout drawings in each burn room; G
Anchor bolts details and layout at burn rooms; G

SD-03 Product Data

Cut sheet information on refractory panels in burn rooms; G
MSDS reports for refractory panels in burn rooms

SD-06 Test Reports

Tests, Inspections, and Verifications

1.3 QUALITY ASSURANCE

Manufacturer shall have 10 years' of experience in the design and fabrication of refractory panels. Panel erector shall be qualified by the supplier and have a minimum 5 years' of experience installing refractory panels.

The contractor shall take field dimensions to verify "as built" conditions to ensure proper fit of refractory panels.

Provide test reports to ensure panels are rated for temperatures greater than 1650 degrees F.

1.4 DELIVERY, STORAGE & HANDLING

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.

1.5 WARRANTY

Provide a (5) year warranty plan warranting all refractory panels to be free from defects in materials and workmanship under service. See Section 01 78 00.

PART 2 PRODUCTS

2.1 SUPPLIERS

Acceptable Suppliers:

1. Westemp by Fire Facilities; 314 Wilburn Rd., Sun Prairie, WI 53590. TEL 1-800-929-3726 Website <http://www.firefacilities.com/products/burn-rooms.php>

2. System 203 by High Temperature Linings; PO Box 1240, White Stone, VA, 22578. TEL 1-800-411-6313 Website <http://www.firetrain.com/system-203>

3. Super Padgenite HD by WHP Trainingtowers, 9130 Flint, Overland Park, KS 66214. TEL 913-385-3663 Website www.trainingtowers.com

4. Mightylite by Refractory Specialties Incorporated (RSI); 230 West California Ave., Sebring, OH 44672. TEL 330-938-2101 Website <http://www.rsifibre.com/markets-served/fire-rated.php>

2.2 MATERIALS

Refractory panels to conform to UFC 4-179-01, ASCE 7, ASTM C24-09, ASTM C447-03, ASTM C165, ASTM C177, and ASTM C182-88.

2.3 PERFORMANCE

Refractory panels and accessories shall be free from asbestos or other harmful ingredients, and shall not produce toxic bi-products in the course of the intended use.

Refractory panels and accessories shall be capable of protecting the wall and ceiling surfaces of concrete from damage due to enclosed fires. Insulating material shall be 1 inch thick and pre-cut and heat treated. Panels shall be capable of continuous service at temperature ranges from 1200 to 1650 degrees F. Panels shall be pre-treated with a two part chemical system to be water resistant/repellent. Seams and joints shall be backed with 1 inch thick battens of similar material. Use of "speed clips," insulating clips or building insulation washers is prohibited. Steel plate sheathing will be provided in front of panels to protect panels from high pressure hose spray.

System shall withstand repeated exposure to heat and the application of water to heated surfaces without the breakdown of insulating properties. Insulating materials shall not require "drying out" periods following the application of water nor be subject to "spalling" due to heat/moisture conditions. There shall be no restrictions placed upon use due to atmospheric conditions or ambient temperatures.

There shall be no restrictions imposed upon the nature of the Class A fuel source, the fire location within neither the room nor any requirement of "special" precautions prior to ignition.

The insulating system shall be mounted to the existing concrete walls with an air gap behind the panels as indicated on drawings. Provide suitable fasteners and detail connections to allow for panel to move during heating and cooling cycle. Direct attachment of panels to the building structure will not be permitted. The fasteners of the panels shall be tightened to allow the washer to be rotated by hand with some resistance. This is critical to allowing the panel to move during the heating and cooling cycle.

A full set of installation drawings shall be prepared by the panel supplier and submitted for approval, which clearly shows the panel layout and attachment layout.

The contractor shall coordinate with supplier field measurements so supplier can pre-cut panels and treat prior to shipping. Minimize the field cutting of panels.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that anchor bolts are at the proper spacing and protrude the proper amount above the concrete. Report any variances to the Contracting Officer prior to erecting refractory panels.

3.2 INSTALLATION

Comply with the respective manufacturer's recommendations for preparation of building components.

Comply with respective manufacturer's instructions and approved shop

drawings.

3.3 ADJUSTING AND CLEANING

Repair or replace damaged components.

Contractor shall properly maintain the site, collect all waste material, place all debris and waste in containers and remove from the site.

-- 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 E2174	(2014) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
ASTM E814	(2013a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Reprint Oct 2012) Fire Tests of Through-Penetration Firestops
UL 723	(2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2012) 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.

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 of compliance with UL 1479.
- c. Submit documentation of training and experience for Installer.
- d. Submit inspection report 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 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

Firestopping Materials; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

Inspector Qualifications
Firestopping Materials
Installer Qualifications; G

1.4 QUALITY ASSURANCE

1.4.1 Installer

Engage an experienced Installer who is:

- a. FM Research approved in accordance with FM 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 Inspector Qualifications

The inspector shall have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

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 and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic 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 E84 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 E814 or UL 1479. Fire resistance ratings shall be as follows:

2.1.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = Rating of wall or partition being penetrated.

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. 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

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. 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 and devices as indicated.

3.2.3.1 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Firestopping products shall allow for cable moves, additions or changes. Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

3.3.1 General Requirements

For Navy projects, install one of each type of penetration and have it inspected and accepted by the Naval Facilities Engineering Command, Fire Protection Engineer prior to the installation of the remainder of the penetrations. 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 Contracting Officer. 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 E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

-- 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 C920 (2014a) Standard Specification for
Elastomeric Joint Sealants

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-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 is compatible for use with joint substrates and with MERC roof system wherever contact with that system or system products is encountered.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

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 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S, Grade P, Class 25, Use T.

2.1.2 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.

2.1.2.1 Foam Strip

Provide foam strip of polyurethane or polyvinylchloride foam. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature must be minus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed into adjacent finishes. Saturate treated strips with butylene waterproofing or impregnated with asphalt.

2.2 POURABLE SEALANTS

Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates. Provide pourable sealant from the following as recommended and approved by the manufacturer:

- a. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type M, Grade P, Class 100/50, for Use T.

- b. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant:
ASTM C920, Type S, Grade P, Class 25, for Use T.
- c. Multicomponent, Pourable, Traffic-Grade, Polysulfide Joint Sealant:
ASTM C920, Type M, Grade P, Class 25, for Use T.

2.3 HIGH TEMPERATURE SEALANT

- a. For joints in horizontal surfaces, capable of resisting water infiltration and chemical resistance to propane. Concrete Chamfer Cants.
- b. Capable of withstanding temperatures up to 250 degrees F.
- c. Basis of Design: Dow Corning^(R) 890-SL Silicone Joint Sealant.

2.4 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.5 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.

2.6 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.

2.7 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

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 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.

3.2 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:

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
For concrete:		
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. Concrete 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.

-- End of Section --

SECTION 09 67 23.13

STANDARD RESINOUS FLOORING

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.

ASTM INTERNATIONAL (ASTM)

ASTM A 990	(2008) Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosive Service
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D 1475	(1998; R 2008) Standard Test Method for Density of Liquid Coatings, Inks, and Related Products
ASTM D 1544	(2004) Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
ASTM D 1652	(2004) Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2471	(1999) Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
ASTM D 445	(2006) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 570	(1998; R 2005) Standard Test Method for Water Absorption of Plastics
ASTM D 638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D 696	(2003) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30

degrees C With a Vitreous Silica
Dilatometer

ASTM D4259

(1988; R 2012) Standard Practice for
Abrading Concrete

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-02 Shop Drawings

Submit Fabrication Drawings in accordance with the paragraph entitled, "Drawings," of this section.

Submit installation drawings for heavy duty epoxy flooring systems in accordance with the paragraph entitled, "Application of Floor Topping," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Epoxy-Resin Binder/Matrix
Cured Epoxy Binder
Walnut Shell Aggregate
Surface Sealing Coat

SD-04 Samples

Submit samples on Hardboard in accordance with paragraph entitled, "Sampling," of this section.

SD-05 Design Data

Submit mix designs (Contractor and job) for the following items including a complete list of ingredients and admixtures. Applicable test reports must verify that the mix has been successfully tested and meets design requirements.

Epoxy-Resin Binder/Matrix
Cured Epoxy Binder
Surface Sealing Coat

SD-06 Test Reports

A copy of the Records of Inspection after completion of the contract in accordance with paragraph entitled, "Quality Assurance," of this section.

SD-07 Certificates

Submit Listing of Product Installations in accordance with paragraph entitled, "Qualifications," of this section.

Submit certificates for the following showing conformance with the referenced standards contained in this section.

Epoxy-Resin Binder/Matrix
Cured Epoxy Binder
Walnut Shell Aggregate
Surface Sealing Coat

1.3 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in original packages, containers, or bundles bearing brand name and name of material.

Maintain materials used in the installation of floor topping at a temperature between 65 and 85 degrees F.

1.4 QUALITY ASSURANCE

Submit a copy of the Records of Inspection, as well as the records of corrective action taken.

1.4.1 Qualifications

A Listing of Product Installations for heavy duty epoxy flooring must 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. List must include purchaser, address of installation, service organization, and date of installation.

Applicators installing the floor topping must have had experience in the application of troweled walnut-shell aggregate thin-set floor topping.

1.4.2 Sampling

Provide three samples on Hardboard not less than 12 inch square for each required color.

Panels must show nominal thickness of finished toppings and color and texture of finished surfaces. Finished floor toppings must match the approved samples in color and texture.

1.4.3 Drawings

Submit Fabrication Drawings for heavy duty epoxy flooring Systems consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MIXES

2.1.1 Epoxy-Resin Binder/Matrix

Epoxy-resin binder to be a clear two-component compatible system consisting of: (1) a liquid blend of a biphenol-based epoxy resin and an aliphatic polyglyceridyl ether, and (2) a liquid blend of two modified amine curing

agents, which individually cures the epoxy resin at room temperature to a glossy smooth film. Two components and the cured epoxy binder must have the following physical properties:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
COMPONENT A (EPOXY RESIN)		
Viscosity (kinematic), at 77 degrees F, centipoises	ASTM D 445	3000 to 5000
Weight per epoxide, grams	ASTM D 1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D 1544	5
Weight per gallon, pounds	ASTM D 1475	9.46 - 9.56
COMPONENT B (CURING AGENT)		
Viscosity (kinematic), at 77 degrees F, centistokes	ASTM D 445	75 to 125
Weight per gallon, pounds	ASTM D 1475	7.50 to 7.60
Color (Gardner Color Scale), maximum	ASTM D 1544	8

2.1.2 Cured-Epoxy Binder

Combine components A and B in the proportions specified by the manufacturer to form a clear compatible system immediately on mixing. Cure combined components to a clear film possessing a glossy, nongreasy surface at relative humidities less than 80 percent, and have the following properties after curing 24 hours at 77 degrees F, followed by 24 hours at 125 degrees F:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
Tensile strength, psi* at test temperature: 77 degrees F	ASTM D 638	4500 to 6500
Tensile elongation, percent* at test temperature: 77 degrees F	ASTM D 638	20 to 40
Water absorption, percent 24 hours at 77 degrees F, maximum	ASTM D 570	0.40
Hardness, Shore D	ASTM D 2240	74 to 82
Linear shrinkage, inch/inch maximum	ASTM C 881/C 881M	0.006
Shrinkage, glass bow, inch divergence, maximum	ASTM A 990	0.016
Coefficient of linear thermal	ASTM D 696	200 X 10 ⁻⁶

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>REQUIREMENT</u>
expansion, inch/inch/degree C, maximum	0 degrees C to 40 degrees C	
Gel time/peak exotherm at 77 degrees F, 100 gm mass in 4-ounce metal container	ASTM D 2471	20 to 40 minutes at 300 degrees F, maximum

*1/8 inch thick castings

**1/8 by 1 by 3 inch castings, aged in forced draft oven

2.1.3 Walnut Shell Aggregate

Walnut shell aggregate must be delivered to the site in three separate package gradations for blending. Gradations to be furnished to be:

<u>SIEVE SIZE</u>	<u>PERCENT</u>	
	<u>MAXIMUM</u>	<u>MINIMUM</u>
GRADATION NO. 1		
Retained on No. 6	0.0	-
Passing No. 6, retained on No. 8	5.0	0.0
Passing No. 8, retained on No. 12	100.0	74.0
Passing No. 20	1.0	-
GRADATION NO. 2		
Retained on No. 16	0.0	-
Passing No. 16, retained on No. 18	5.0	0.0
Passing No. 18, retained on No. 40	100.0	85.0
Passing No. 40, retained on No. 60	9.0	0.0
Passing No. 60	1.0	-
GRADATION NO. 3		
Retained on No. 20	0.0	-
Passing No. 20, retained on No. 35	5.0	0.0
Passing No. 35, retained on No. 60	100.0	80.0
Passing No. 60, retained on No. 100	13.0	0.0
Passing No. 100	2.0	-

2.1.4 Surface Sealing Coat

Surface sealer must be nonambering aliphatic or aromatic moisture-curing polyurethane into which has been incorporated a suitable flatting agent.

Add flattening agent not more than 24 hours prior to actual application of the coating. Cured coating with flattening agent must give 60-degree specular gloss of 10 to 20 when tested in accordance with ASTM D 523.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, provide forced ventilation to ensure that vapor concentration is kept at acceptable limits recommended by the manufacturer of the product.

Erect "NO SMOKING" signs, and prohibit smoking or use of spark- or flame-producing devices within 50 feet of any mixing or placing operation involving flammable materials.

Personnel required to handle, mix, or apply toppings containing toxic or flammable properties must be provided with, and required to wear, such items of personal protective equipment and apparel for eye, skin, and respiratory protection as are recommended by the manufacturer of the product.

Accomplish sand blasting under approved controlled conditions with respect to sand and dust control to prevent damage to personnel and facility.

3.2 PREPARATION

3.2.1 Existing Concrete Floors

Clean existing concrete floors, with demolished resinous flooring or contaminated areas in conformance with ASTM D4259, and ensure concrete is free of all paint, resinous flooring, sealers, curing agents, oil, grease, moisture, dirt or any other contaminants. Remove any loose or corroded segments of existing concrete and patch with a grouting compound as recommended by the resinous flooring manufacturer. Fill all cracks with an elastomeric jointing compound compatible with the resinous flooring system used.

3.2.2 Mixing Of Materials

Job mix proportions are based on the trial batch proportions used to prepare the floor topping samples submitted and approved. Binder aggregate ratio normally range from 1:2 to 1:2.3 (by weight), since mixtures providing satisfactory density, trowelability, and surface texture are affected by variations in particle shapes, sizes, and size distribution. Blend three different walnut shell aggregate gradations (by weight) as follows: 1 part No. 1; 1.15 parts No. 2; and 1.15 parts No. 3. Minor adjustments of the mix proportions of the approved floor topping samples are permitted, subject to approval.

Use mechanical equipment for mixing of materials. Use rotating replaceable 5- to 16-gallon pail mixers for blending components A (epoxy resin) and B (curing agent) of epoxy binder.

Use rotating paddle-type masonry mortar mixers for preblending the three sizes and color pigment, if any, of the walnut shell aggregate and addition

of the mixed epoxy resin binder. Mixing times to be as recommended by the materials supplier(s), provided mixing times result in homogeneous mixtures. In case the equipment used does not provide uniform mixtures in the times recommended, with approval, adjust the mixing times. Limit quantity of material mixed at one time to that which can be applied and finished within the working life of the mixtures. Temperature of materials at the time of mixing must be between 65 and 85 degrees F.

3.2.3 Protection

In addition to the protection of adjacent surfaces during installation, areas used to store and mix materials must have a protective covering under the materials. After application of the sealer coats, protect finished flooring during the remainder of the construction period. In areas of expected minimum or moderate traffic, cover floors with 70-pound kraft paper, a 30-30-30 waterproof kraft paper, or an approved substitute, with strips taped together and edges secured to prevent roll-up. Vegetable fiberboard, plywood, or other suitable material that does not mar the flooring must be placed over the paper to protect areas used as passages by workmen and areas subject to floor damage because of subsequent building operations. Upon completion of construction, remove the protection, clean flooring and, where necessary, repair, reseal, or both, at no additional cost to the Government.

3.3 APPLICATION OF FLOOR TOPPING

Anchor plates set with the top surface at or above the finished epoxy floor level do not require coverage with this flooring material. Extend flooring under equipment, except when the equipment base is indicated to be flush against the structural floor. Cover and/or mask surfaces not to receive the epoxy floor topping, such as equipment or cabinets installed prior to surface-preparation efforts and adjacent to the flooring installation.

Prepared subfloor surface must be dry and at a temperature of not less than 60 degrees F when application of the floor topping is initiated. Immediately prior to application of the prime/scratch coat on the prepared surface, remove dust or other loose particles by blowing with compressed air or vacuum cleaned. Air compressor used must be equipped with an efficient oil-water trap to prevent oil contamination or wetting of surface.

Apply a thin roller coat of the epoxy binder specified to the prepared subfloor as a prime coat. As an aid to placing, compacting, and finishing the floor topping, the forming of a scratch coat by sprinkling a minimum quantity of the walnut shell aggregate on the prime coat surface immediately following the prime coat application is allowed. Prime coat application rate must be approximately 150 square feet per gallon. Prior to application of the prime/scratch coat, fill cracks in the concrete, and make provisions to keep control or expansion joints open.

Place the floor topping prior to final gelling of the prime/scratch coat. Immediately after the materials are mixed as specified, dump the mixture in the placement area and spread to prolong troweling life. Screed or rough trowel placed materials to the specified thickness and then compact by the use of a smooth roller prior to finish troweling to a nominal thickness of 3/16 inch plus or minus 1/16 inch. Finished surface must be free of ridges, hollows (bird-baths), and trowel marks, and smoothness must vary not more than 1/8 inch when tested with an 8-foot straightedge. Make provisions to maintain the work areas in a relatively dust-free environment during curing of the topping.

After the floor topping has set firmly (approximately 6 to 16 hours depending on subfloor temperature) in a relatively dust-free environment, apply two thin coats of the sealer coat, by means of brush, roller, squeegee, or notched trowel to provide a pore-free, easy-to-clean surface. At the time of sealer application, the surface must be dust-free. Depending on relative humidity, the applied sealer must cure to a tack-free condition in 2 to 4 hours. Second coat must not be applied until after the initial coat has cured to a tack-free, hard film. Maintain topping areas in a relatively dust-free environment during curing of the sealer coats.

Provide a 4 inch high cove base to all concrete wall surfaces as noted on drawings. Install so as to provide a 1/2 inch radius at the juncture of the floor and the wall.

3.4 FIELD QUALITY CONTROL

3.4.1 Repairing

Damaged and unacceptable portions of completed work must be removed and replaced with new work to match adjacent surfaces at no additional cost to the Government.

3.5 CLEANING

Clean surfaces of the new work, and adjacent surfaces soiled as a result of the work. Equipment, surplus materials, and rubbish from the work must be removed from the site.

-- 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 0100 (2001; Supplements 2002-2008)
Documentation of the Threshold Limit
Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D6386 (2010) Standard Practice for Preparation
of Zinc (Hot-Dip Galvanized) Coated Iron
and Steel Product and Hardware Surfaces
for Painting

MASTER PAINTERS INSTITUTE (MPI)

MPI 107 (Oct 2009) Rust Inhibitive Primer
(Water-Based)

MPI 47 (Oct 2009) Interior Alkyd, Semi-Gloss, MPI
Gloss Level 5

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal
Primer

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01 (2000) Environmentally Preferable Product
Specification for Architectural and
Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and
Maintenance Painting of Steel

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
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev D; Notice 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
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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.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-03 Product Data

Coating; G
Manufacturer's Technical Data Sheets

Indicate VOC content.

SD-04 Samples

Coating colors; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

SD-08 Manufacturer's Instructions

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.3 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 similar metal systems 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:
 - 1) Position or responsibility
 - 2) Employer (if other than the Contractor)
 - 3) Name of facility owner
 - 4) Mailing address, telephone number, and telex number (if non-US) of facility owner
 - 5) Name of individual in facility owner's organization who can be contacted as a reference
 - 6) Location, size and description of structure
 - 7) Dates work was carried out
 - 8) Description of work carried out on structure

1.4 REGULATORY REQUIREMENTS

1.4.1 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.

1.4.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.4.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.4.4 Asbestos Content

Materials shall not contain asbestos.

1.4.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.4.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.4.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.5 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.

1.6 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.6.1 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.

1.7 LOCATION AND SURFACE TYPE TO BE PAINTED

1.7.1 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.

1.7.1.1 Interior Painting

Includes existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations.

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. Comply with applicable regulations regarding toxic and hazardous materials.

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, stains, splinters, loose particles, grease, oil, disintegrated coatings, rust, 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 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.
- d. Surfaces with stains shall be cleaned with a commercial biocide. Area shall be rinsed as directed by manufacturer.

3.2.2 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, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC SP 7/NACE No.4; Water jetting to SSPC SP 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

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.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

3.3.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall

not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

- b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12/NACE No.5 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

3.4 APPLICATION

3.4.1 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.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops,

ridges, waves, laps, brush marks, and variations in colors.

3.4.2 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.

3.4.3 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.

3.4.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table	
<u>INTERIOR</u>	
Division 5.	Interior Metal, Ferrous and Non-Ferrous Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

- (1) One coat of primer.
- (2) One coat of undercoat or intermediate coat.
- (3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.5 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior.

- 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.

3.6 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.

3.7 WASTE MANAGEMENT

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.

3.8 PAINT TABLES

All DFT's are minimum values. Acceptable products are listed in the MPI

Green Approved Products List, available at
<http://www.specifygreen.com/APL/ProductIdxByMPInum.asp>.

3.8.1 INTERIOR PAINT TABLES

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE		
<u>INTERIOR STEEL / FERROUS SURFACES</u>		
A. Metal railings, ladders, exposed surfaces indicated on Drawings.		
1. High Performance Architectural Latex		
MPI INT 5.1R-G5 (Semigloss)		
Primer: MPI 79	Intermediate: MPI 47	Topcoat: MPI 47
System DFT: 5.25 mils		
2. Alkyd		
MPI INT 5.1E-G5 (Semigloss)		
Primer: MPI 79	Intermediate: MPI 47	Topcoat: MPI 47
System DFT: 5.25 mils		
MPI INT 5.1E-G6 (Gloss)		
Primer: MPI 79	Primer: MPI 79	Topcoat: MPI 48
System DFT: 5.25 mils		

-- End of Section --

SECTION 13 48 00

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT
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.

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)

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307 (2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A36/A36M (2012) Standard Specification for Carbon Structural Steel

ASTM A500/A500M (2013) 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 A563 (2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A572/A572M (2013a) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

ASTM A603 (1998; R 2014) Standard Specification for Zinc-Coated Steel Structural Wire Rope

ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

the Hot-Dip Process

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04

(2013) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section, to the mechanical equipment and systems outlined in Section 23 05 48.00 40 VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT, and the miscellaneous equipment and systems listed below, in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Risk Category II and on site response coefficients for $S_{DS} = 0.121$ g and $S_{D1} = 0.088$ g. Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in UFC 3-310-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas are required.

1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

Ductwork
HVAC Equipment

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

Bracing; G
Resilient Vibration Isolation Devices; G
Equipment Requirements; G

SD-03 Product Data

Bracing; G
Equipment Requirements; G

SD-06 Test Reports

Anchor Bolts; G

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations. Calculations shall be stamped, by a registered engineer, and verify the capability of structural members to which bracing is attached for carrying the load from the brace.

2.1.1 Rigidly Mounted Equipment

The following specific items of equipment: HP-2 to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished: Bracing shall be constructed and assembled to resist a horizontal lateral force of 0.5 times the operating weight of the equipment at the vertical center of gravity of the equipment.

2.2 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A307 for bolts and ASTM A563 for nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground and/or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A36/A36M or ASTM A572/A572M, Grade 503. If the Contractor does the design, both ASTM A36/A36M and ASTM A572/A572M, grade 503 will be allowed.
- b. Wire rope, ASTM A603.
- c. Tubes, ASTM A500/A500M, Grade B.
- d. Pipes, ASTM A53/A53M, Type E or S, Grade B.
- e. Light gauge angles, less than 1/4 inch thickness, ASTM A653/A653M.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Secure trapeze-type hanger with not less than two 1/2 inch bolts.

3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

3.3.1 Cast-In-Place

Use cast-in-place anchor bolts, conforming to ASTM A307, for floor or pad mounted equipment, except as specified below. Provide two nuts on each bolt. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Select vibration isolation devices so that the maximum movement of equipment from the static deflection point is 1/2 inch.

3.4.2 Multidirectional Seismic Snubbers

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment. These snubbers shall provide 1/4 inch free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 SWAY BRACES FOR PIPING

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Provide bracing consisting of at least one vertical angle 2 by 2 inch by 16 gauge and one diagonal angle of the same size.

3.5.1 Longitudinal Sway Bracing

Provide longitudinal sway bracing in accordance with Section 23 05 48.00 40 VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (in)	Maximum Length* (ft-in)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40s)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment

Provide equipment sway bracing for items supported from overhead floor or

roof structural systems. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-310-04 without exceeding safe working stress of bracing components. Provide, for approval, specific force calculations in accordance with UFC 3-310-04 for the equipment in the project. Submit details of equipment bracing for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.6.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

3.7 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

-- End of Section --

SECTION 21 21 02.00 20

CARBON DIOXIDE FIRE EXTINGUISHING TANK (LOW PRESSURE)

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.

ASME INTERNATIONAL (ASME)

ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M (2014) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

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 12 (2011) Standard on Carbon Dioxide Extinguishing Systems

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

NFPA 72 (2013) National Fire Alarm and Signaling Code

NFPA 75 (2013; Errata 2013) Standard for the Protection of Information Technology Equipment

NFPA 90A (2015) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-2962 (Rev A; Notice 2) Enamel, Alkyd, Gloss,
Low VOC Content

FS TT-P-645 (Rev C) Primer, Paint, Zinc-Molybdate,
Alkyd Type

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

1.2 DEFINITIONS

- a. Installer: The installer of the low-pressure carbon dioxide fire extinguishing compressor and tank; either the Contractor or the subcontractor proposed by the Contractor to perform the work and with whom the Contractor has a firm contractual agreement.

1.3 SYSTEM DESCRIPTION

Provide new low-pressure carbon dioxide storage compressor and tank. Design, equipment, materials, installation, workmanship, examination, inspection, and testing shall be in accordance with required and advisory provisions of NFPA 12, NFPA 70, NFPA 72, NFPA 75, and NFPA 90A, except as modified herein. Each system shall include all materials, accessories, and equipment inside and outside the building 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 other construction and equipment in accordance with the approved submitted drawings.

1.3.1 As-Built Record Drawings

After completion, but before final acceptance of the work, submit a complete set of as-built (record) drawings of each system for record purposes. Drawings shall be not smaller than 30 by 42 inches reproducible drawings on mylar film with title block (8 by 4 inches) similar to full-size contract drawings. Submit the as-built (record) working drawings in addition to the as-built contract drawings required by Division 1, "General Requirements."

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

Electrical wiring diagrams; G

Actuating station

SD-03 Product Data

Refrigerated storage tank; G

Valves; G

Alarm bells; G

Pressure relief devices; G

Pipe and fittings; G

Pipe hangers and supports; G

Warning signs; G

For valves, include data for tank shut-off valve, master valve, selector valves, and by-pass valves. Data shall clearly indicate compatibility of detectors with control panel provided and maximum number of detectors permitted per zone.

SD-06 Test Reports

Submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use.

System preliminary tests; G

SD-07 Certificates

Parts reliability; G

Installer qualifications; G

Test procedures; G

Installation personnel; G

Current UL listings or FM approvals; G

Contractor's material and test certificate; G

Pipe and fittings; G

SD-10 Operation and Maintenance Data

As-built Record Drawings

Refrigerated storage tank, Data Package 3; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Installer Qualifications

Prior to installation, submit evidence including system type and design showing that installer has successfully installed at least two low-pressure

carbon dioxide fire extinguishing systems conforming to the requirements of NFPA and of the same type and design specified herein. Include names and locations of the installations and written certification from the users that the systems have performed satisfactorily for a period of not less than 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.

1.5.1.2 Carbon Dioxide System Technician or Engineer

Make installation, adjustments, and tests under the supervision of a technician or engineer retained by the Contractor who is qualified with at least 2 years experience in the installation and operation of low-pressure carbon dioxide fire extinguishing systems of the type specified.

1.5.2 Parts Reliability

Certify that materials and equipment furnished are identical to items that have been in satisfactory use for at least two years prior to bid opening.

1.5.3 Test Procedures

Submit detailed test procedures for the low-pressure carbon dioxide fire extinguishing system 60 calendar days prior to performing system tests.

1.5.4 Installation Personnel

Submit names of personnel who will supervise installation and testing of system, and who will instruct government personnel. Submit manufacturer's certification of named individuals' qualifications.

1.5.5 UL Listings or FM Approvals

Submit copies of current UL listings or FM approvals for the system in configurations offered.

1.5.6 System Preliminary Tests

After successfully completing final acceptance tests and making corrections, submit test results in booklet form showing field tests performed were in compliance with specified performance criteria. Submit certificates for preliminary tests on piping system.

1.5.7 Contractor's Material and Test Certificate

Submit certificate.

1.5.8 Regulatory Requirements

Materials and equipment for carbon dioxide fire protection system shall be listed by UL Fire Prot Dir, or approved by FM APP GUIDE. Provide current materials and equipment manufacturer regularly engaged in production of

such equipment and essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.5.9 Modification of References

In the NFPA 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 Great Lakes Division, Naval Facilities Engineering Command, Fire Protection Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

Store and protect equipment from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.7 MAINTENANCE

1.7.1 Special Tools

Furnish to the Contracting Officer, suitable special tools required for maintenance of equipment, and a metal tool box for said special tools.

1.7.2 Spare Parts

- a. Two of each type of fuse required by the system and;
- b. Five complete sets of system keys.

PART 2 PRODUCTS

2.1 CARBON DIOXIDE TANK SYSTEM

NFPA 12, except as modified herein.

2.1.1 Systems Supply

Provide an approved low-pressure (300 psig) refrigerated carbon dioxide storage tank, complete with full charge of carbon dioxide, and necessary components and appurtenances. Provide 3 3/4 ton low-pressure refrigerated carbon dioxide storage tank.

2.2 PIPE AND FITTINGS

2.2.1 Pipe

Hot-dipped galvanized, threaded end connections; Schedule 80 for continuous pressure piping between storage tank and selector valves, and Schedule 40 for piping not under continuous pressure.

- a. ASTM A53/A53M, Type E (electric-resistance welded, Grades A or B) or Type S (seamless, Grades A or B).
- b. ASTM A106/A106M, Grades A or B.

2.2.2 Threaded Fittings

ASME B16.11, hot-dipped galvanized, for continuous pressure pipe fittings between storage tank and selector valves, and between selector valves and

hand hose stations and ASME B16.3, Class 150, hot-dipped galvanized, for pipe fittings not under continuous pressure.

2.3 PRESSURE RELIEF DEVICES

Provide each section of closed piping with an approved pressure relief device designed to operate at 450 psig.

2.4 SYSTEM CONTROL

Provide apparatus, accessories, components, and associated materials specified or required. Provide automatic electric type of actuating control system complete and ready for operation.

2.5 OPERATING POWER

Provide independent, properly fused safety switches, 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. Finish switch boxes with red enamel and identify by a lettered designation. Provide wiring in accordance with NFPA 70. Wiring for 120 volt circuits shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 14 AWG minimum. Wiring shall be color coded. Provide wiring in metal conduit or electrical metallic tubing.

2.6 CONDUCTOR IDENTIFICATION

Identify circuit conductors within each enclosure where a tap, splice, or termination is made. Use plastic-coated, self-sticking printed markers or by heat-shrink type sleeves for conductor identification. Attach markers to prevent accidental detachment. Identify control circuit terminations.

2.7 OPERATING INSTRUCTIONS

Provide operating instructions at each remote actuating station. Clearly indicate steps for system operation in instructions. Use raised or embossed white letters on red rigid plastic or enameled steel backgrounds. Use lettering at least 1/4 inch high.

2.7.1 Identification Signs

Provide identification signs for system operating devices and control valves. Provide signs of three-layer composition having a red face and engraved one inch minimum white letters.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of discrepancies before performing the work.

3.2 INSTALLATION

Install piping straight and true to bear evenly on hangers and supports. Keep interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other

approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.2.1 Electrical

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide control wiring under this section in accordance with NFPA 70. 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.

3.2.2 Pipe and Fittings

Inspect, test, and approve piping before concealing. Provide fittings for direction changes in piping and for connections. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only to male threads. Provide exposed ferrous pipe threads with one coat of FS TT-P-645 primer applied to a minimum dry film thickness of 1.0 mil. Use Schedule 80 steel pipe, hot-dipped galvanized for pipe nipples 6 inches long and shorter. Provide tapered-reducing pipe fittings for changes in piping size; bushings will not be permitted. Minimum nominal pipe size for hose and systems shall be 0.75 inch.

3.2.3 Pipe Hangers and Supports

Provide additional supports for the concentrated loads in piping between pipe hangers and supports, such as for valves. Support steel piping as follows:

MAXIMUM SPACING (FEET)									
Nominal Pipe Size (Inches)	1.0 and Under	1.25	1.5	2	2.5	3	4	5	6
Steel Piping	7	8	9	10	11	12	14	16	17

3.3 FIELD PAINTING

Clean, pretreat, prime, and paint new carbon dioxide fire extinguishing systems including valves, piping, conduit, hangers, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide metal surfaces with one coat of FS TT-P-645 primer applied to a minimum dry film thickness of 1.0 mil. Shield operating devices with protective covering while painting is in process. Upon completion of painting, remove protective covering from operating devices. Remove devices which are painted and replace with new devices. Provide primed surfaces with the following:

3.3.1 Exterior Systems

Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of

CID A-A-2962 red 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 tape bands spaced at maximum of 20 foot intervals throughout the piping systems, except in finished areas, such as offices, red bands may be deleted.

3.4 CORROSION AND FUNGUS PREVENTION

Protect metallic materials against corrosion. Coat outdoor equipment with a rust inhibiting treatment and standard finish by the manufacturer. Do not use aluminum in contact with the earth. Protect dissimilar metals with approved fittings and treatment. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a single layer of a pressure sensitive plastic tape, half-lapped. Protect components against corrosion and fungus.

3.5 FIELD QUALITY CONTROL

Perform tests to determine conformance with specified requirements in the presence of the Contracting Officer. Refer to Section 01 91 00.00 40 COMMISSIONING for additional testing and commissioning requirements.

3.5.1 Tests During Installation

Pneumatically test each piping system at 150 psig for a 2-hour period with no leakage or reduction in gage pressure. Gages shall be calibrated. Individually test components and accessories to demonstrate proper functioning. Correct deficiencies prior to formal functional and operating tests of the system. Furnish carbon dioxide required for tests.

3.5.2 Final Performance and Acceptance Tests

After the system has been in service for at least 30 calendar days, notify the Naval Facilities Engineering Command and Fire Protection Engineer, in writing that the system is ready for final acceptance tests. Furnish notification at least 15 calendar days prior to the date of the final acceptance test. Consider the system ready for testing after necessary preliminary tests have been made and deficiencies have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Naval Facilities Engineering Command and Fire Protection Engineer. An experienced technician regularly employed by the system installer shall be present during the inspection.

3.5.2.1 Acceptance Testing

Furnish proposed test procedures for approval at least 60 calendar days prior to commencement of acceptance testing. Perform the tests in the presence of the Naval Facilities Engineering Command and Fire Protection Engineer, or authorized representative under the supervision of the carbon dioxide system manufacturer's qualified representative. Furnish instruments, labor, and materials required for the tests. Arrange for the technician who supervised the installation to conduct the tests. Correct deficiencies found and retest the system. Repeat tests specified in paragraph entitled "Tests During Installation" as directed by the Naval Facilities Engineering Command and Fire Protection Engineer, during final acceptance tests. Submit copies of performance test reports in accordance with paragraph entitled "Field Test Reports." After successful completion of tests, refill storage tank with carbon dioxide.

3.5.3 Additional Tests

When deficiencies, defects, or malfunctions develop during required tests, suspend further testing of system until proper adjustments, corrections, or revisions have been made to ensure proper performance of system. When these revisions require more than a nominal delay, notify the Contracting Officer when the additional work has been completed to arrange a new inspection and test of the low-pressure carbon dioxide fire extinguishing system. Repeat tests required prior to final acceptance, unless directed otherwise.

3.5.4 Manufacturer's Field Services

3.5.4.1 Manufacturer's Representative

Furnish services of a qualified manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided to supervise testing, including final testing, and system adjustment.

3.5.4.2 Instructions of Government Personnel

Conduct a training course for operating staff as designated by the Contracting Officer. Training period shall consist of no less than one 8-hour working day, and shall start after system is functionally completed but prior to final acceptance tests. Field instructions shall cover items contained in the operating and maintenance instructions, Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION. Refer to Section 01 91 00.00 40 COMMISSIONING for additional training requirements.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2010; ERTA 2011-2013) Energy Standard for
Buildings Except Low-Rise Residential
Buildings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (2010; Addenda 2011) Hypochlorites

AWWA B301 (2010) Liquid Chlorine

AWWA C203 (2008) Coal-Tar Protective Coatings and
Linings for Steel Water Pipelines - Enamel
and Tape - Hot-Applied

AWWA C606 (2011) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding
Code - Steel

ASME INTERNATIONAL (ASME)

ASME A112.36.2M (1991; R 2012) Cleanouts

ASME A112.6.3 (2001; R 2007) Standard for Floor and
Trench Drains

ASME A112.6.4 (2003; R 2012) Roof, Deck and Balcony
Drains

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)

ASME B16.12 (2009; R 2014) Cast Iron Threaded Drainage
Fittings

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe
Flanges

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings:
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B31.1	(2014; INT 1-47) Power Piping
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications
ASTM INTERNATIONAL (ASTM)	
ASTM A105/A105M	(2013) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2014) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
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 A74	(2013a) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A888	(2013a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C564	(2014) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications
ASTM D3122	(1995; R 2009) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings

ASTM D3139 (1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM D3212 (2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F1760 (2001; R 2011) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

ASTM F477 (2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (2009) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI 310 (2011) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (2012) International Plumbing Code

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

MSS SP-25 (2013) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

MSS SP-69 (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2011; Errata 2012) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2015) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 372 (2011) Drinking Water System Components -
Lead Content

NSF/ANSI 61 (2013) Drinking Water System Components -
Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2010) Firestopping: Plastic Pipe in Fire
Resistive Construction

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

PL 109-58 Energy Policy Act of 2005 (EPA05)

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-03 Product Data

List of installed fixtures with manufacturer, model, and flow
rate.

Floor Drains

Water level Sensors

Chemical Feed Pumps; G

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the
ASME Boiler and Pressure Vessel Code, the design, fabrication, and
installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts
furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION

AND MAINTENANCE SUPPORT INFORMATION.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 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.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 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.

1.3.4.1 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."

1.3.4.2 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.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with AWS D1.1/D1.1M.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.7 PROJECT/SITE CONDITIONS

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

1.8 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.

1.9 ACCESSIBILITY OF EQUIPMENT

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

2.1 Materials

Materials for various services shall be in accordance with TABLES I and II. PVC pipe shall contain a minimum of 25 percent recycled content in accordance with ASTM F1760. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12).
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.

- f. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.
- g. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- h. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.
- i. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.
- j. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D3122.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Metallic Cleanouts: ASME A112.36.2M.
- b. Hypochlorites: AWWA B300.
- c. Liquid Chlorine: AWWA B301.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 DRAINS

2.3.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3.

2.3.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

2.3.3 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.6.4, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.4 PUMPS

2.4.1 Chemical Feed Pumps

The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. Volumetric accuracy of the pumps shall be within one percent over the range indicated. Pump capacities shall be adjustable by positioning crank pin with micrometer setscrews. Stroke length scale shall be divided in percentage graduations engraved on scale. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge. The pumps shall be controlled by an external controller/timer receiving signals from the makeup water meter.

Drive motors shall be 110 volt, single phase and shall have drip-proof enclosures. Each pump shall be mounted and piped with black iron pipe and fittings, with suction strainer and stainless steel screen, and with 1/2 inch relief valve with steel body and stainless steel trim.

2.5 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current

motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6 MISCELLANEOUS PIPING ITEMS

2.6.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.6.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.6.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.6.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.6.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.6.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.6.5 Water Level Sensors

For tanks #1, #2 and #3, provide wire suspended probes compatible with process water and associated chemicals. Probes shall be stainless steel 316. Wiring shall be insulated with PVC coating for use in corrosive conditions. Wire shall be to length as required to meet existing conditions. Wiring cable connection shall be compatible with existing junction box or provide new means of connection to existing junction box.

For tank #4, provide packaged liquid level kit complete with tank level sensors and controller. Controller shall be capable of sending signal to existing fresh water shut off valve. Kit shall operate at 120VAC. All electrical shall be per National Electrical Code. Water level probes shall be cut to length as required to meet existing conditions.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, and accessories. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc.,

where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.6 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.2 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and

fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint

sealant.

3.1.4.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.4.3 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.4.4 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.5 Supports

3.1.5.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.5.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic

loads as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.1.5.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Horizontal pipe runs shall include allowances for expansion and contraction.
- i. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- j. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.1.5.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.6 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.7 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor.

3.2 IDENTIFICATION SYSTEMS

3.2.1 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.4 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.4.1 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.

3.4.1.1 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.

3.5 TESTS, FLUSHING AND DISINFECTION

3.5.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.5.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.5.3 System Flushing Process Water

3.5.3.1 During Flushing

Before operational tests process water piping system shall be flushed with water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor

shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.5.3.2 After Flushing Process Water

System shall be drained at low points. A basket strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions.

3.5.3.3 Cleaning Basket Strainer and Housing

Do not hit basket strainer against housing. This could cause damage to mesh. Clean existing strainer by thoroughly rinsing mesh strainer with clean pressurized water. Remove all sludge and debris from strainer basket and housing.

For damaged mesh screen, replace with heavy duty stainless steel, 30 mesh screen.

3.5.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Operation of each floor by flooding with water.

Refer to Section 01 91 00.00 40 COMMISSIONING for additional testing and commissioning requirements.

3.6 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.7 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions

explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.8 TABLES

TABLE I							
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS							
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 4	X		X	X		
4	Steel pipe, seamless galvanized, ASTM A53/A53M, Type S, Grade B	X			X	X	

-- End of Section --

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST 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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

- ASHRAE 62.1 (2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality
- ASHRAE 70 (2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets

ASTM INTERNATIONAL (ASTM)

- ASTM A123/A123M (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM A53/A53M (2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A924/A924M (2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
- ASTM B766 (1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
- ASTM C553 (2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- ASTM D1654 (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D3359 (2009; E 2010; R 2010) Measuring Adhesion
by Tape Test

ASTM D520 (2000; R 2011) Zinc Dust Pigment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2011; Errata 2012) Motors and Generators

NEMA MG 10 (2013) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (2010) Standard Methods of Fire Tests for
Flame Propagation of Textiles and Films

NFPA 90A (2015) 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 1981 (2008) Seismic Restraint Manual Guidelines
for Mechanical Systems, 3rd Edition

U.S. DEPARTMENT OF ENERGY (DOE)

PL-109-58 (1992; R 2005) Energy Efficient
Procurement Requirements

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

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Nov 2014) Electrical Rigid
Metal Conduit-Steel

UL Bld Mat Dir (2012) Building Materials Directory

UL Electrical Constructn (2012) Electrical Construction Equipment
Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in

pipng and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

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

Detail Drawings; G

SD-03 Product Data

Duct Connectors
Duct Access Doors; G
Manual Balancing Dampers; G
Diffusers
Registers and Grilles

SD-06 Test Reports

Performance Tests; G

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G
Manual Balancing Dampers; G

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

- a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient

evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

- b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.
- c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.
- d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or ENERGY STAR covered product categories, equipment selected shall have as a minimum the efficiency rating identified under "Energy-Efficient Products" at <http://femp.energy.gov/procurement> and <http://energy.gov/eere/femp/covered-product-category>.

These specifications conform to the efficiency requirements as defined in Public Law PL-109-58, "Energy Policy Act of 2005" for federal procurement of energy-efficient products. Equipment having a lower efficiency than ENERGY STAR or FEMP requirements may be specified if the designer determines the equipment to be more life-cycle cost effective using the life-cycle cost analysis methodology and procedure in 10 CFR 436.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

- a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.

- b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.
- c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the Contracting Officer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

- a. Proof of Technician Certification
- b. Proof of Equipment Certification for recovery or recycling equipment.
- c. Proof of availability of certified recovery or recycling equipment.

1.4.4 Use of Ozone Depleting Substances, Other than Refrigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

- a. Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon
- b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays.
- c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial cabling.
- d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Contracting Officer. The waiver will be evaluated and dispositioned.

1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 4 weeks prior to the start of related testing.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units", provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

- a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.
- b. Prior to this two year period, these standard products shall have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or have been identified with a manufacturer's document number.
- c. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible

adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for operating platforms, are specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.4 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.
- c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.
- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.6 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

2.7 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.9 DUCT SYSTEMS

2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

- a. Ductwork shall be constructed meeting the requirements for the duct system static pressure specified in APPENDIX D of Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.
- b. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.
- c. Provide ductwork that meets the requirements of Seal Class A.
- d. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.

2.9.1.1 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.9.1.2 High Temperature Service Duct Connections

Provide material that is approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

2.9.1.3 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167

2.9.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and

plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.9.3 Manual Balancing Dampers

- a. Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators.
- b. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.
- c. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.3.1 Square or Rectangular Dampers

2.9.3.1.1 Duct Height 12 inches and Less

2.9.3.1.1.1 Frames

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.9.3.1.1.2 Single Leaf Blades

Width	Height	Galvanized Steel Thickness	Length
Maximum 19 inches	Maximum 12 inches	Minimum 20 gauge	Minimum 3 inches
More than 19 inches	Maximum 12 inches	Minimum 16 gauge	Minimum 3 inches

2.9.3.1.1.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

Width	Height	Material	Square Shaft
Maximum 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 3/8 inch
More than 19 inches	Maximum 12 inches	Galvanized Steel	Minimum 1/2 inch

2.9.3.1.1.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

Width	Height	Material
Maximum 19 inches	Maximum 12 inches	solid nylon, or equivalent solid plastic, or oil-impregnated bronze
More than 19 inches	Maximum 12 inches	oil-impregnated bronze

2.9.3.1.1.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.3.1.1.6 Finish

Mill Galvanized

2.9.3.1.2 Duct Height Greater than 12 inches

2.9.3.1.2.1 Dampers

Provide dampers with multi-leaf opposed-type blades.

2.9.3.1.2.2 Frames

Maximum 48 inches in height; maximum 48 inches in width; minimum of 16 gauge galvanized steel, minimum of 5 inches long.

2.9.3.1.2.3 Blades

Minimum of 16 gauge galvanized steel; 6 inch nominal width.

2.9.3.1.2.4 Blade Axles

To support the blades of round dampers, provide galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

2.9.3.1.2.5 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

2.9.3.1.2.6 Blade Actuator

Minimum 1/2 inch diameter galvanized steel.

2.9.3.1.2.7 Blade Actuator Linkage

Mill Galvanized steel bar and crank plate with stainless steel pivots.

2.9.3.1.2.8 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.9.3.1.2.9 Finish

Mill Galvanized

2.9.4 Diffusers, Registers, and Grilles

Provide factory-fabricated units of corrosion-resistant steel or aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.9.4.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Constructn for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.9.4.2 Perforated Plate Diffusers

Provide adjustable two-way, air pattern controls as indicated. Provide diffuser faceplates that do not sag or deflect when operating under design conditions.

2.9.4.3 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.10 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Factory painting that has been damaged prior to acceptance by the Contracting Officer shall be field painted in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.11 SUPPLEMENTAL COMPONENTS/SERVICES

2.11.1 Glycol Water Piping

The requirements for glycol water piping and accessories are specified in

Section 23 05 15 COMMON PIPING FOR HVAC.

2.11.2 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 23 05 15 COMMON PIPING FOR HVAC except as modified herein.

2.11.3 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.11.4 Controls

The requirements for controls are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS and 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

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

- a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
- b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices) and an additional 2 feet.
- c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.7 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums up to the point where the outdoor air reaches the conditioning unit or up to the point where the outdoor air mixes with the return air stream.

3.2.8 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.3 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.4 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.5 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.5.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.5.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.5.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.5.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6 FIELD PAINTING OF MECHANICAL EQUIPMENT

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 clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. 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. Provide aluminum or light gray finish coat.

3.7 IDENTIFICATION SYSTEMS

Provide identification tags made of engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Make indentations black for reading clarity.

3.8 DUCTWORK LEAK TESTS

The requirements for ductwork leak tests are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.9 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by

having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.10 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.11 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area. Refer to Section 01 91 00.00 40 for additional testing and commissioning requirements.

Submit test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.12 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of air-handling units, heating and ventilating units thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.13 OPERATION AND MAINTENANCE

3.13.1 Operation and Maintenance Manuals

Submit five manuals at least 2 weeks prior to field training. Submit data

complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.13.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 8 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course. Coordinate with requirements located in Section 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION. Refer to Section 01 91 00.00 40 for additional training requirements.

-- End of Section --

SECTION 23 01 30.41

HVAC SYSTEM CLEANING

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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1 (2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality

NATIONAL AIR DUCT CLEANERS ASSOCIATION (NADCA)

ACR (2013) Standard for Assessment, Cleaning, and Restoration of HVAC Systems

NADCA HVAC Inspection Manual (2005) Procedures for Assessing the Cleanliness of Commercial HVAC Systems

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA AH112 (1993) Cleaning Fibrous Glass or Lined Sheet Metal Ducts

NAIMA AH122 (2006) Cleaning Fibrous Insulated Duct Systems - Recommended Practices

NAIMA AH127 (1999) Impact of Duct Cleaning on Internal Duct Insulation

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 2011) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 402-C-01-001 (2001) IAQ Building Education and Assessment Tool (I-BEAM)

EPA 402-F-91-102 (1991) Building Air Quality: A Guide for Building Owners and Facility Managers

UNDERWRITERS LABORATORIES (UL)

UL 181 (2013) Factory-Made Air Ducts and Air Connectors

UL 181A (2013) Standard for Closure Systems for

Use with Rigid Air Ducts and Air Connectors

UL 181B

(2013) Standard for Closure Systems for
Use with Flexible Air Ducts and Air
Connectors

1.2 DEFINITIONS

1.2.1 NADCA Standards

Perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (ACR and NADCA HVAC Inspection Manual).

- a. All terms in this specification are defined as stated in the NADCA Standards.
- b. Follow NADCA Standards without modification or deviation.

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

Record of Existing Conditions; G

Coordination Plan; G

NADCA Firm; G

Designation of NADCA Team Assistants; G

Designation of NADCA Air System Cleaning Specialist (ASCS); G

Designation of NADCA Supervisor Qualifications; G

Records of Experience in the Field of HVAC System Cleaning

NADCA Work Execution Schedule; G

SD-06 Test Reports

Testing Procedures Summary; G

Post-Project Report; G

1.4 QUALITY ASSURANCE

1.4.1 NADCA Firm

To secure approval for the proposed agency, submit information certifying that the NADCA firm is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including furnishing equipment. Further, submit the following, for the firm, to Contracting Officer for approval:

a. Independent NADCA firm:

NADCA Firm: NADCA registration number and expiration date of current certification;

NADCA Supervisor Qualifications: Name and copy of NADCA supervisor certificate and expiration date of current certification.

NADCA Air System Cleaning Specialist (ASCS): Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of HVAC cleaning work in the field for not less than 3 years immediately preceding this contract's bid opening date.

NADCA Team Assistants: Names and documented evidence that each field technician has satisfactorily assisted a NADCA team field leader in performance of HVAC cleaning work in the field for not less than one year immediately preceding this contract's bid opening date.

Current Certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the HVAC cleaning work, in a timely manner so that there is no lapse in registration or certification. NADCA agency or NADCA team personnel without a current registration or current certification are not to perform HVAC cleaning work on this contract.

b. TAB Team Members: NADCA team approved to accomplish work on this contract are full-time employees of the NADCA firm. No other personnel is allowed to do HVAC cleaning work on this contract.

c. Replacement of NADCA Team Members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.4.2 Experience

Submit records of experience in the field of HVAC system cleaning. Bids will only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

1.4.3 Equipment, Materials and Labor

Possess and furnish all necessary equipment, materials and labor to adequately perform the specified services and comply with the applicable provisions of NADCA General Specifications for the Cleaning of Commercial HVAC Systems and ASHRAE 62.1.

a. Assure that all employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and Material Safety Data Sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., comply with applicable national safety codes and standards.

b. Maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all

other site documentation requirements of applicable OSHA programs and this specification.

- c. Submit all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process, including all VOC ratings.

1.5 STANDARDS

1.5.1 NADCA Standards

Perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (ACR and NADCA HVAC Inspection Manual).

- a. All terms in this specification have their meaning defined as stated in the NADCA Standards.
- b. Follow NADCA Standards with no modifications or deviations being allowed.

1.6 DOCUMENTS

1.6.1 Mechanical Drawings

Obtain one copy of the following documents:

- a. Project drawings and specifications
- b. Approved construction revisions pertaining to the HVAC system
- c. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

Submit a NADCA Work Execution Schedule to the Contracting Officer within 10 working days of the contract award.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SCOPE OF WORK

3.1.1 Scope

This section defines the **minimum** requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards. Conform all inspection work to NADCA HVAC Inspection Manual.

Remove visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts

(except ceiling plenums and mechanical room) to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, supply air ducts, fans, fan housing, fan blades, turning vanes, filters, filter housings, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

3.2 HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS

3.2.1 HVAC System Evaluation

Prior to the commencement of any cleaning work, perform a visual inspection of the HVAC system in the presence of the Contracting Officer to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. Notify the Contracting Officer 20 days prior to the planned inspection.

Document damaged system components found during the inspection and submit to the Contracting Officer, clearly labeled "Record of Existing Conditions."

3.2.2 Site Evaluation and Preparations

Conduct a site evaluation, and establish a specific, coordination plan which details how each area of the building will be protected during the various phases of the project.

3.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

3.3.1 Containment

Collect debris removed during cleaning and take precautions to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.

3.3.2 Particulate Collection

Where the Particulate Collection Equipment (PCE) is exhausting inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater). When the PCE is exhausting outside the building, undertake Mechanical Cleaning operations only with PCE, including adequate filtration to contain Debris removed from the HVAC system. When the PCE is exhausting outside the building, take precautions to locate the equipment down wind and away from all air intakes and other points of entry into the building.

3.3.3 Controlling Odors

Take all reasonable measures to control offensive odors and/or mist vapors during the cleaning process.

3.3.4 Component Cleaning

Employ cleaning methods such that all HVAC system components are Visibly Clean as defined in applicable standards. Upon completion, return all components to those settings recorded just prior to cleaning operations.

3.3.5 Air-Volume Control Devices

Mark the position of dampers and any air-directional mechanical devices inside the HVAC system prior to cleaning and, upon completion, restore to their marked position.

3.3.6 Service Openings

Utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection. Utilize the existing service openings already installed in the HVAC system where possible.

Create other openings where needed, created and resealed in conformance with NADCA Standard 05. Place closures so they do not significantly hinder, restrict, alter the air-flow within the system, or compromise the structural integrity of the system. Properly insulate closures to prevent heat loss/gain or condensation on surfaces within the system. Conform construction techniques used in the creation of openings to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards. Cutting service openings into flexible duct is not permitted. Disconnect flexible duct at the ends as needed for proper cleaning and inspection.

Reseal rigid fiber glass ductboard duct systems in accordance with NAIMA recommended practices; NAIMA AH112, NAIMA AH122, and NAIMA AH127. Only closure techniques which comply with UL 181, UL 181A, or UL 181B are suitable for fiber glass duct system closures.

Clearly mark all service openings, capable of being re-opened for future inspection or remediation, and report their location in project report documents.

3.3.7 Air Distribution Devices (Registers, Grilles and Diffusers)

Clean all air distribution devices.

3.3.8 Air Handling Units, Blowers and Exhaust Fans

Insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. Remove all visible surface contamination deposits in accordance with NADCA Standards.

- a. Clean all air handling unit (AHU) internal surfaces, components and condensate collectors and drains.
- b. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
- c. Clean all coils and related components, including evaporator fins.

3.3.9 Duct Systems

- a. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
- b. Mechanically clean all duct systems to remove all visible contaminants,

such that the systems are capable of passing Cleaning Verification Testings NADCA Standards.

3.4 HEALTH AND SAFETY

3.4.1 Safety Standards

Comply with all applicable federal, state, and local requirements for protecting the safety of the contractors' employees, building occupants, and the environment. In particular, follow all applicable standards of the Occupational Safety and Health Administration (OSHA) when working in accordance with this specification, and EM 385-1-1.

3.4.2 Occupant Safety

Employ no processes or materials in such a manner that they will introduce additional hazards into occupied spaces.

3.4.3 Disposal of Debris

Dispose of all debris removed from the HVAC System in accordance with applicable federal, state and local requirements.

3.5 MECHANICAL CLEANING METHODOLOGY

3.5.1 Source Removal Cleaning Methods

Clean the HVAC system using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. Select Source Removal methods which will render the HVAC System Visibly Clean and capable of passing cleaning verification methods NADCA Standards and other specified standards and tests, in accordance with all general requirements. Use no cleaning method, or combination of methods, which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

Incorporate the use of vacuum collection devices that are operated continuously during cleaning for all methods used. Connect a vacuum device to the downstream end of the section being cleaned through a predetermined opening. Use a vacuum collection device of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

Equip all vacuum devices exhausting air inside the building, including hand-held vacuums and wet-vacuums, with HEPA filters (minimum efficiency).

Equip all vacuum devices exhausting air outside the facility with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system, in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors which violates any outdoor environmental standards, codes or regulations is not allowed.

All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

3.5.2 Cleaning of Coils

Use any cleaning method which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification applicable NADCA Standards. Coil drain pans are subject to Non-Porous Surfaces Cleaning Verification. Maintain operability of the drain for the condensate at all times. Do not damage, displace, inhibit heat transfer, or cause erosion of the coil surface or fins, and conform to coil manufacturer recommendations when available. Thoroughly rinse coils with clean water to remove any latent residues.

3.5.3 Antimicrobial Agents and Coatings

Only apply antimicrobial agents if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

Perform application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants after the removal of surface deposits and debris.

Use only antimicrobial agents registered by the U.S. Environmental Protection Agency (EPA 402-F-91-102) (EPA 402-C-01-001) specifically for use within HVAC system.

Apply antimicrobial agents in strict accordance with manufacturer's instructions.

Use only antimicrobial coating products, for both porous and non-porous surfaces, which are EPA registered, water soluble solutions with supporting efficacy data and MSDS records.

Apply antimicrobial coatings according to manufacturer's instructions. Spray coatings directly onto interior ductwork surfaces, rather than "fog" downstream onto surfaces. Achieve a continuous film on the surface to be treated by the coating application, and apply in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

3.6 CLEANLINESS VERIFICATION

3.6.1 General

Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including antimicrobial agents and coatings.

3.6.2 Visual Inspection

Visually inspect the HVAC system to ensure that no visible contaminants are present.

If no contaminants are evident through visual inspection, consider the HVAC system clean; however, further verification of the system cleanliness through gravimetric or wipe testing analysis testing may be requested at the discretion of the Contracting Officer, as specified herein.

If visible contaminants are evident through visual inspection, re-clean those portions of the system where contaminants are visible, and subject to re-inspection for cleanliness.

3.6.3 Verification of Coil Cleaning

Cleaning is to restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA HVAC Inspection Manual Standards).

3.7 POST-PROJECT REPORT

At the conclusion of the project, provide a Testing Procedures Summary and Post-Project Report indicating the following:

- a. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
- b. Areas of the system found to be damaged and/or in need of repair.

-- 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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2012; Errata 2012; INT 1-4 2012; INT 5-7
2013) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2011; Errata 2012) Motors and Generators

NEMA MG 10 (2013) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2
2013; Errata 2 2013; AMD 3 2014; Errata
3-4 2014; AMD 4-6 2014) National
Electrical Code

1.2 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.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product

shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a 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.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 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."

1.3.5.2 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.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before

and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.6.4 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower and larger 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.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. 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. Refer to Section 01 91 00.00 40 for additional training requirements.

1.8 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 05 15

COMMON PIPING FOR HVAC
02/14

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

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

AWS WHB-2.9 (2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME A112.19.2/CSA B45.1 (2013) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals

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 B16.22 (2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

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 B16.4 (2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9 (2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.3 (2012) Process Piping

ASME B36.10M	(2004; R 2010) Standard for Welded and Seamless Wrought Steel Pipe
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2013) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M	(2014) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	(2004; R 2014) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197/A197M	(2000; R 2011) Standard Specification for Cupola Malleable Iron
ASTM A234/A234M	(2013; E 2014) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A276	(2013a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A312/A312M	(2014b) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A6/A6M	(2014) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B32	(2008) Standard Specification for Solder

Metal

ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B749	(2003; R 2009) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM C109/C109M	(2013) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C404	(2011) Standard Specification for Aggregates for Masonry Grout
ASTM C476	(2010) Standard Specification for Grout for Masonry
ASTM C553	(2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C67	(2013a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM E1	(2013) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E814	(2013a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM F104	(2011) Standard Classification System for Nonmetallic Gasket Materials
ASTM F2389	(2010) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

FLUID SEALING ASSOCIATION (FSA)

FSA-0017	(1995e6) Standard for Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical Handbook
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-125	(2010) Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2011) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(2013) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2013) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
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U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	(1982; Rev B; Notice 2 2009) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-DTL-17813	(2009; Rev H; Supp 1 2009; Notice 1 2013) Expansion Joints, Pipe, Metallic Bellows, General Specification for

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 2) Shield, Expansion (Caulking Anchors, Single Lead)
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)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 2) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Reprint Oct 2012) Fire Tests of Through-Penetration Firestops
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1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section

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 the existing conditions.

Include with Equipment Foundation Data for piping systems all 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 Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Connection Diagrams for 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 Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

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

List of qualified permanent service organizations

SD-02 Shop Drawings

Record Drawings; G
Connection Diagrams
Coordination Drawings
Installation Drawings

SD-03 Product Data

Piping Specialties; G
Valves; G
Equipment Foundation Data
Pipe and Fittings
Miscellaneous Materials
Surface Resistance
Shear and Tensile Strengths
Temperature Ratings

SD-06 Test Reports

Air Tests; G
Bending Tests
Flattening Tests
Transverse Guided Weld Bend Tests
Hydrostatic Tests
Valve-Operating Tests
Drainage Tests
Pneumatic Tests
Non-Destructive Tests
System Operation Tests

SD-10 Operation and Maintenance Data

Records of Existing Conditions
Record of satisfactory field operation

Operation and Maintenance Manuals; G

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. Provide standard products in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has 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 are 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

Ensure the equipment items are supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Select service organizations that are 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

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not 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 are considered mandatory, the word "should" is interpreted as "shall." Reference to the "code official" is interpreted to mean the "Contracting Officer." For Navy owned property, interpret references to the "owner" to mean the "Contracting Officer." For leased facilities, references to the "owner" is interpreted to mean the "lessor." References to the "permit holder" are 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, are applied as appropriate by the Contracting Officer and 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 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Ensure motors, controllers, disconnects and contactors conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors is not permitted. Provide controllers and contactors with 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, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.7 ELECTRICAL INSTALLATION REQUIREMENTS

Ensure electrical installations conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.7.2 High Efficiency Motors

1.7.2.1 High Efficiency Single-Phase Motors

Unless otherwise specified, provide high efficiency single-phase fractional-horsepower alternating-current motors corresponding to the applications listed in NEMA MG 11.

1.7.2.2 High Efficiency Polyphase Motors

Unless otherwise specified, select polyphase motors based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, ensure polyphase squirrel-cage medium induction motors with continuous ratings meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.7.3 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower and larger 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.

1.8 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. Provide instructors thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction 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 is 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.

1.9 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

2.1 PIPE AND FITTINGS

Submit equipment and performance data for pipe and fittings consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.1.1 Type BCS, Black Carbon Steel

Ensure pipe 1/8 through 12 inches is Schedule 40 black carbon steel, conforming to ASTM A53/A53M.

Ensure pipe 1/8 through 10 inches is Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M, Type S (seamless). Grade A should be used for permissible field bending, in both cases.

Ensure fittings 2 inches and under are 150-pounds per square inch, gage

(psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure unions 2 inches and under are 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Ensure flanges 2-1/2 inches and over are 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.1.2 Type BCS-125, 125-psi Service

Ensure pipe 1/8 through 1-1/2 inches is Schedule 40 steam, Schedule 80 condensate, furnace butt weld, black carbon steel, conforming to ASTM A53/A53M, Type F (furnace butt welded, continuous welded) and ASME B36.10M.

Ensure pipe 2 through 10 inches is Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M Type S (seamless) and ASME B36.10M.

Ensure fittings 2 inches and under are 125-psig wsp, cast iron, screwed end, conforming to ASTM A126 Class A and ASME B16.4.

Ensure fittings 2 inches and under are 150-psig wsp banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure fittings 1 through 2 inches are 2,000-or 3,000-psi water, oil, or gas (wog) to match pipe wall, forged carbon steel socket weld, conforming to ASTM A105/A105M and ASME B16.11.

Ensure fittings 2 inches and under are 125-psig wsp, cast iron, screwed end, conforming to ASTM A126 Class A and ASME B16.4.

Ensure fittings 2-1/2 inches and over are wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A234/A234M, Grade WPB and ASME B16.9.

Ensure couplings 2 inches and under are commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 2,000-or 3,000-psi wog forged carbon steel, conforming to ASTM A105/A105M and ASME B16.11, where welded.

Ensure flanges 2-1/2 inches and over are 150-pound, forged carbon-steel welding neck, with raised face or flat face and concentric serrated finish, conforming to ASTM A105/A105M and ASME B16.5.

2.1.3 Type CPR, Copper

2.1.3.1 Type CPR-A, Copper Above Ground

Ensure tubing 2 inches and under is seamless copper tubing, conforming to ASTM B88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Ensure fittings 2 inches and under are 150-psig wsp wrought-copper solder joint fittings conforming to ASME B16.22.

Ensure unions 2 inches and under are 150-psig wsp wrought-copper solder

joint, conforming to ASME B16.22.

Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.

Use solder, alloy Sb-5, conforming to ASTM B32.

2.2 PIPING SPECIALTIES

Submit equipment and performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.2.1 Air Separator

Air separated from converter discharge water is ejected by a reduced-velocity device vented to the compression tank.

Provide a commercially constructed separator, designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Provide shop drawings detailing all piping connections proposed for this work.

Ensure the air separator is carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.2.2 Air Vents

Provide manual air vents using 3/8-inch globe valves.

Provide automatic air vents on pumps, mains, and where indicated using ball-float construction. Ensure the vent inlet is not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice size is 1/8 inch. Provide corrosion-resistant steel trim conforming to ASTM A276. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 150 psi. Ensure outlet is copper tube routed.

2.2.3 Compression Tank

Provide compression tank designed, fabricated, tested, and stamped for a working pressure of not less than 125 psi in accordance with ASME BPVC SEC VIII D1. Ensure tank is hot-dip galvanized after fabrication to produce not less than 1.5 ounces of zinc coating per square foot of single-side surface.

Tank accessories include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

2.2.4 Dielectric Connections

Electrically insulate dissimilar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.2.5 Expansion Vibration Isolation Joints

Construct single or multiple arch-flanged expansion vibration isolation joints of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. Coat all nonmetallic exterior surfaces of the joint with chlorosulphinated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Fill arches with soft chloroprene.

Ensure joint, single-arch, movement limitations and size-related, pressure characteristics conform to FSA-0017.

2.2.6 Flexible Pipe

Construct flexible pipe vibration and pipe-noise eliminators of wire-reinforced, rubber-impregnated cloth and cord materials and be flanged. Back the flanges with ferrous-metal backing rings. Ensure service pressure-rating is a minimum 1.5 times actual service, with surge pressure at 180 degrees F.

Construct flexible pipe vibration and pipe noise eliminators of wire-reinforced chloroprene-impregnated cloth and cord materials. Ensure the pipe is flanged. Provide all flanges backed with ferrous-metal backing rings. Coat nonmetallic exterior surfaces of the flexible pipe with an acid- and oxidation-resistant chlorosulphinated polyethylene. Rate the flexible pipe for continuous duty at 130 psi and 250 degrees F.

Ensure unit pipe lengths, face-to-face, are not less than the following:

<u>INSIDE DIAMETER</u>	<u>UNIT PIPE LENGTH</u>
To 2-1/2 inches, inclusive	12 inches
3 to 4 inches, inclusive	18 inches
To 3 inches, inclusive	18 inches
4 to 10 inches, inclusive	24 inches
12 inches and larger	36 inches

2.2.7 Flexible Metallic Pipe

Ensure flexible pipe is the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Minimum working pressure rating is 100 psi at 300 degrees F.

Ensure minimum burst pressure is four times working pressure at 300 degrees F. Bellows material is AISI Type 316L corrosion-resistant steel. Ensure braid is AISI 300 series corrosion-resistant steel wire.

Ensure welded end connections are Schedule 80 carbon steel pipe, conforming

to ASTM A106/A106M, Grade B.

Provide threaded end connections; hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312/A312M.

Ensure flanged end connection rating and materials conform to specifications for system primary-pressure rating.

2.2.8 Metallic Expansion Joints

Provide metallic-bellows expansion joints conforming to MIL-DTL-17813.

Provide Type I expansion joints; (corrugated bellows, unreinforced), Class 1 (single bellows, expansion joint).

Design and construct joints to absorb all of the movements of the pipe sections in which installed, with no detrimental effect on pipe or supporting structure.

Rate, design, and construct joints for pressures to 125 psig and temperatures to 500 degrees F.

Ensure joints have a designed bursting strength in excess of four times their rated pressure.

Ensure joints are capable of withstanding a hydrostatic test of 1.5 times their rated pressure while held at their uncompressed length without leakage or distortion that may adversely affect their life cycle.

Ensure life expectancy is not less than 10,000 cycles.

Ensure movement capability of each joint exceeds calculated movement of piping by 100 percent.

Provide bellows and internal sleeve material of AISI Type 304, 304L, or 321 corrosion-resistant steel.

End connections require no field preparation other than cleaning.

Flanges of flanged-end expansion joints conforms to the same codes and standard requirements as are applicable to companion flanges specified for the given piping system at the indicated joint location.

Provide joints, 2-1/2 inches and smaller, with internal guides and limit stops.

Provide joints, 3 inches and larger, with removable external covers, internal sleeves, and purging connection. Size sleeves to accommodate lateral clearance required, with minimum reduction of flow area, and with oversized bellows where necessary. When a sleeve requires a gasket as part of a locking arrangement, provide the gasket used by the manufacturer. Joints without purging connection may be provided; however, remove these from the line prior to, or not installed until, cleaning operations are complete.

Provide the cylindrical end portion of the reinforced bellows element with a thrust sleeve of sufficient thickness to bring that portion within applicable code-allowable stress. Provide 360 degrees support for the element and end-reinforcing ring with the sleeve.

Ensure expansion joints have four, equidistant, permanent tram points clearly marked on each joint end. Locate points to prevent obliteration during installation. Include distance between tram points indicating installed lengths in shop drawings. Overall dimension after joint installation is subject to approval from the Contracting Officer.

Ensure each expansion joint has adjustable clamps or yokes provided at quarter points, straddling the bellows. Overall joint length is set by the manufacturer to maintain joints in manufacturer's recommended position during installation.

Permanently and legibly mark each joint with the manufacturer's name or trademark and serial number; the size, series, or catalog number; bellows material; and directional-flow arrow.

2.2.9 Pressure Gages

Ensure pressure gages conform to ASME B40.100 and to requirements specified herein. Pressure-gage size is 3-1/2 inches nominal diameter. Ensure case is corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6/A6M, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Align service-pressure reading at midpoint of gage range. Ensure all gages are Grade B or better and be equipped with gage isolators.

2.2.10 Sleeve Couplings

Sleeve couplings for plain-end pipe consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.2.11 Thermometers

Ensure thermometers conform to ASTM E1, except for being filled with a red organic liquid. Provide an industrial pattern armored glass thermometer, (well-threaded and seal-welded). Ensure thermometers installed 6 feet or higher above the floor have an adjustable angle body. Ensure scale is not less than 7 inches long and the case face is manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.2.12 Pump Suction Strainers

Provide a cast iron strainer body, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction is such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Ensure minimum ratio of open area of each basket to pipe area is 3 to 1. Provide a basket with AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Ensure mesh is capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Provide reducing fittings from strainer-flange size to pipe size.

Provide a differential-pressure gage fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.2.13 Line Strainers, Water Service

Install Y-type strainers with removable basket. Ensure strainers in sizes 2-inch ips and smaller have screwed ends; in sizes 2-1/2-inch ips and larger, strainers have flanged ends. Ensure body working-pressure rating exceeds maximum service pressure of installed system by at least 50 percent. Ensure body has cast-in arrows to indicate direction of flow. Ensure all strainer bodies fitted with screwed screen retainers have straight threads and gasketed with nonferrous metal. For strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, provide offset blowdown holes. Fit all strainers larger than 2-1/2-inches with manufacturer's standard ball-type blowdown valve. Ensure body material is cast bronze conforming to ASTM B62. Where system material is nonferrous, use nonferrous metal for the metal strainer body material.

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.045-inch. Ensure strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is AISI Type 304 corrosion-resistant steel.

2.3 VALVES

Submit equipment and performance data for valves consisting of corrosion resistance and life expectancy. Submit design analysis and calculations consisting of rates of flow, head losses, inlet and outlet design, and pressure calculations. Also include in data, pipe dimensions, as well as temperature ratings, vibration and thrust limitations, minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

Polypropylene valves will comply with the performance requirements of ASTM F2389.

2.3.1 Ball and Butterfly Valves

Ensure ball valves conform to MSS SP-72 for Figure 1A, 1 piece body 1B, vertically split body 1C three piece body and are rated for service at not less than 175 psig at 200 degrees F. For valve bodies in sizes 2 inches and smaller, use screwed-end connection-type constructed of Class A copper alloy. For valve bodies in sizes 2-1/2 inches and larger, use flanged-end connection type, constructed of Class D material. Balls and stems of valves 2 inches and smaller are manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger are manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Ensure valves are suitable for flow from either direction and seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Ensure all valves have adjustable packing glands. Seats and seals are fabricated from tetrafluoroethylene.

Ensure butterfly valves conform to MSS SP-67 and are the wafer type for mounting between specified flanges. Ensure valves are rated for 150-psig

shutoff and nonshock working pressure. Select bodies of cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals are fabricated from resilient elastomer designed for field removal and replacement.

2.3.2 Drain, Vent, and Gage Cocks

Provide lever handle drain, vent, and gage cocks, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125-psi wsp. Ensure end connections are rated for specified service pressure.

Ensure pump vent cocks, and where spray control is required, are UL umbrella-hood type, constructed of manufacturer's standard polished brass. Ensure cocks are 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.3.3 Gate Valves (GAV)

Ensure gate valves 2 inches and smaller conform to MSS SP-80. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated use union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Use rising stem type valves.

Ensure gate valves 2-1/2 inches and larger, are Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Select flanged valves, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.3.4 Globe and Angle Valves (GLV-ANV)

Ensure globe and angle valves 2 inches and smaller, are 125-pound, 125-psi conforming to MSS SP-80 and to requirements specified herein. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated, use union-ring bonnet, screwed-end type. Ensure disc is free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Ensure disk and packing are suitable for pipe service installed.

Ensure globe and angle valves, 2-1/2 inches and larger, are cast iron with bronze trim. Ensure valve bodies are cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-80. Select flanged valves in conformance with ASME B16.1. Valve construction is outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.3.5 Nonslam Check Valves (NSV)

Provide check valves at pump discharges in sizes 2 inches and larger with nonslam or silent-check operation conforming to MSS SP-125. Select a valve disc or plate that closes before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Ensure valve is Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Use valves that are wafer type to fit between flanges conforming to ASME B16.1. Valve body may be cast iron, or equivalent strength ductile iron. Select disks using manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Ensure pins, springs, and miscellaneous trim are manufacturer's standard corrosion-resistant steel.

Disk and shaft seals are Buna-N elastomer tetrafluoroethylene.

2.4 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.4.1 Bituminous Coating

Ensure the bituminous coating is a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and is recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, use bituminous coating solvent cutback coal-tar type, conforming to MIL-C-18480.

2.4.2 Bolting

Ensure flange and general purpose bolting is hex-head and conforms to ASTM A307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts conform to ASTM A563. Square-head bolts and nuts are not acceptable. Ensure threads are coarse-thread series.

2.4.3 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to ASTM C920.

2.4.4 Escutcheons

Manufacture escutcheons from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Ensure metals and finish conforms to ASME A112.19.2/CSA B45.1.

Use one-piece escutcheons where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Ensure all escutcheons have provisions consisting of internal spring-tension devices or setscrews for maintaining a fixed position against a surface.

2.4.5 Flashing

Ensure sheetlead conforms to ASTM B749, UNS Alloy Number L50049 (intended for use in laboratories and shops in general application).

Ensure sheet copper conforms to ASTM B370 and be not less than 16 ounces per square foot weight.

2.4.6 Flange Gaskets

Provide compressed non-asbestos sheets, conforming to ASTM F104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.4.7 Grout

Provide shrink-resistant grout as a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476.

Ensure shrink-resistant grout is a combination of pre-measured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C109/C109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C67	0.1 percent, maximum
Bond strength to		1,000 psi, minimum steel in shear minimum

2.4.8 Pipe Thread Compounds

Use polytetrafluoroethylene tape not less than 2 to 3 mils thick in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Use polytetrafluoroethylene dispersions and other suitable compounds for all other applications upon approval by the Contracting Officer; however, do not use lead-containing compounds in potable water systems.

2.5 SUPPORTING ELEMENTS

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Ensure supporting elements are suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Ensure supporting elements conform to requirements of ASME B31.3, and MSS SP-58, except as noted.

Ensure attachments welded to pipe are made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Ensure supporting elements exposed to weather are hot-dip galvanized or stainless steel. Select materials of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Electroplate supporting elements in contact with copper tubing with copper.

Type designations specified herein are based on MSS SP-58. Ensure masonry anchor group-, type-, and style-combination designations are in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615. Provide support elements, except for supplementary steel, that are cataloged, load rated, commercially manufactured products.

2.5.1 Building Structure Attachments

2.5.1.1 Anchor Devices, Concrete and Masonry

Ensure anchor devices conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615

For cast-in, floor mounted, equipment anchor devices, provide adjustable positions.

Do not use powder-actuated anchoring devices to support any mechanical systems components.

2.5.1.2 Beam Clamps

Ensure beam clamps are center-loading MSS SP-58 Type 20.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 19, 20, or 27 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, determine rod diameter in accordance with referenced standards.

2.5.1.3 C-Clamps

Do not use C-clamps.

2.5.1.4 Inserts, Concrete

Use concrete MSS SP-58 Type 18 inserts. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that, use split-band-type rings in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1, 3 or 4 attachments.

Use MSS SP-58 Type 1 and Type 6 assemblies on vapor-sealed insulated piping and have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, use MSS SP-58 Type 41 pipe rolls.

Support piping in sizes larger than 8-inch ips with MSS SP-58 Type 41 pipe rolls.

Use MSS SP-58 Type 40 shields on all insulated piping. Ensure area of the supporting surface is such that compression deformation of insulated surfaces does not occur. Roll away longitudinal and transverse shield edges from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Provide spring supports as indicated.

2.5.2.2 Parallel Pipes

Use trapeze hangers fabricated from structural steel shapes, with U-bolts, in congested areas and where multiple pipe runs occur. Ensure structural steel shapes conform to supplementary steel requirements.

2.5.3 Vertical Pipe Attachments

Ensure vertical pipe attachments are MSS SP-58 Type 8.

Include complete fabrication and attachment details of any spring supports in shop drawings.

2.5.4 Hanger Rods and Fixtures

Use only circular cross section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 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, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Provide certificates verifying Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Provide test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests, in compliance with referenced standards contained within this section.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-58, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Ensure drawings specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Ensure connections between steel piping and copper piping are electrically isolated from each other with dielectric couplings (or unions) or flanged with gaskets rated for the service.

Make final connections to equipment with unions or flanges provided every 100 feet of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Make screwed joints with specified joint compound with not more than three threads showing after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction. Do not subject the system to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Ensure field welded joints conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

Take all necessary precautions during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Ensure installation conforms to manufacturer's instructions.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Provide riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Provide valves unavoidably located in furred or other normally inaccessible places with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and

standards.

Support piping from building structure. Do not support piping from roof deck or from other pipe.

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there is no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangers on different adjacent service lines running parallel with each other in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Base load rating for all pipe-hanger supports on insulated weight of lines filled with water and forces imposed. Deflection per span is not exceed slope gradient of pipe. Ensure supports are in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, reduce the allowable span proportionately:

<u>PIPE SIZE</u> <u>INCHES</u>	<u>ROD SIZE</u> <u>INCHES</u>	<u>STEEL PIPE</u> <u>FEET</u>	<u>COPPER PIPE</u> <u>FEET</u>
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Provide vibration isolation supports where needed. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT where A/C equipment and piping is installed.

Support vertical risers independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Ensure risers have guides for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and 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.

3.4 PENETRATIONS

Provide effective sound stopping and adequate operating clearance 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 ceilings where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

Accomplish sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Finish foam with a rasp. Ensure vapor barrier is not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, use only mineral wool with openings covered by 16-gage sheet metal.

3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously weld sleeves passing through steel decks to the deck.

Ensure sleeves that extend through floors, roofs, load bearing walls, and fire barriers are continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Form all other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and provides a minimum 3/8-inch clearance. Install a sleeve size to accommodate mechanical and thermal motion of pipe precluding transmission of vibration to walls and the generation of noise.

Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration solid with a mineral fiber conforming to ASTM C553 Type V (flexible blanket), (to 1,000 degrees F). Provide this packing 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, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure all caulked surfaces are oil- and grease-free.

Ensure through-penetration fire stop materials and methods are in accordance with ASTM E814 and UL 1479.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.6 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping

passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. For insulated pipes, select plates large enough to fit around the insulation. Use chrome-plated escutcheons in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.7 FLASHINGS

Provide flashings at penetrations of building boundaries by mechanical systems and related work.

3.8 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Submit test data that is clear and readily legible.

3.9 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

3.9.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied withstands 125 hours in a salt-spray fog test, except that equipment located outdoors withstand 500 hours in a salt-spray fog test. Conduct salt-spray fog test in accordance with ASTM B117, and for that test the acceptance criteria is as follows: immediately after completion of the test, the inspected paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

Ensure the film thickness of the factory painting system applied on the equipment is not 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, design the factory painting system for the temperature service.

3.9.2 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 clean to bare metal, surfaces subject to temperatures in excess of 120 degrees F.

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. Selected color of finish coat is 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 receives one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness

of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F Receives two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

-- End of Section --

SECTION 23 05 48.00 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

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 within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.71 (1983; R 2006) Guide to the Evaluation of
Human Exposure to Vibration in Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE HVAC APP IP HDBK (2011) HVAC Applications Handbook, I-P
Edition

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS (2005) Procedural Standards for TAB
(Testing, Adjusting and Balancing)
Environmental Systems

1.2 ADMINISTRATIVE REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section to the extent applicable.

Section 23 05 15 COMMON PIPING FOR HVAC applies to work specified in this section to the extent applicable.

Ensure all vibration-control apparatus is the product of a single manufacturing source, where possible. Human exposure levels should be considered using ASA S2.71 and NEBB PROCEDURAL STANDARDS.

Scheduled isolation mounting is in inches and is a minimum static deflection.

Spans referred to in Part 2, "Vibration-Isolation Systems Application," means longest bay dimension.

Determine exact mounting sizes and number of isolators by the isolator manufacturer based on equipment that will be installed. Check equipment revolutions per minute (rpm) and spring deflections to verify that resonance cannot occur.

Five working days prior to commencement of installation, submit installation drawings for vibration isolator systems including equipment and performance requirements.

Indicate within outline drawings for vibration isolator systems, overall

physical features, dimensions, ratings, service requirements, and weights of equipment.

Within ten working days of Contract Award, submit equipment and performance data for vibration isolator systems including equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points.

Ensure data includes the following:

- a. Mountings
- b. Bases
- c. Isolators
- d. Vertical Piping

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

Installation Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

Isolators; G

SD-06 Test Reports

Type of Isolator; G

Type of Base; G

PART 2 PRODUCTS

2.1 TYPE OF VIBRATION-ISOLATION PROVISIONS

Design for vibration isolation using NEBB PROCEDURAL STANDARDS or ASHRAE HVAC APP IP HDBK, Chapter 48, as applicable to the following sections.

Submit test reports for testing vibration isolation for each type of isolator and each type of base, and meet referenced standards contained within this section. Include in test reports allowable deflection and measured deflection also meeting referenced standards within this section.

2.1.1 Materials

Ensure rubber is natural rubber and elastomer is chloroprene. Shore A durometer measurement of both materials and range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, ensure specified deflections are modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Ensure weather-exposed metal vibration-isolator parts are corrosion protected. Chloroprene coat springs.

2.1.2 Mountings

Provide the following mountings:

Type B: Double rubber-in-shear with molded-in steel reinforcement in top and bottom. Maximum deflections up to 0.50 inch are allowed.

Type C: Free-standing laterally stable open-spring type for deflections over 0.50 inch, with built-in bearing and leveling provisions, 0.25-inch thick Type A base elastomer pads, and accessories. Ensure outside diameter of each spring is equal to or greater than 0.9 times the operating height of the spring under rated load.

2.1.3 Bases

Provide the following bases:

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Ensure height of steel members is sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Ensure height of steel member does not result in member deflection at midpoint of unsupported span of more than 1/1,440th of the span between isolators. Minimum height is 5 inches.

2.2 VIBRATION-ISOLATION SYSTEMS APPLICATION

Vibration isolation design per NEBB PROCEDURAL STANDARDS or ASHRAE HVAC APP IP HDBK, Chapter 37.

2.2.1 Low-Pressure AHU Locations

Vibration-isolation provisions apply to floor-mounted Air Moving and Conditioning Association Class A packaged central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON\ABOVE	ON\ABOVE	ON\ABOVE
		GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 5 hp	B-U-0.35	C-U-1.0	C-U-1.0	C-U-1.0
7-1/2 hp and over 250 to 500 rpm	B-U-0.35	C-U-1.75	C-U-1.75	C-U-1.75
500 rpm	B-U-0.35	C-U-1.0	C-U-1.5	

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.3 PIPE AND DUCT VIBRATION ISOLATION

Type G: Provide isolators with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1 inch and 3/8 inch, respectively.

Type H: Provide isolators with contained chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

Type J: Provide isolators with elastomers mounted on floor-supported columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

2.3.1 Vertical Piping

Type L: Provide isolators which are pipe base-support devices with one or more contained steel springs. Load devices by supported system during operating conditions to produce a minimum static deflection of 1 inch. Equip devices with precompression and vertical-limit features, as well as a minimum 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

Type M: Provide isolators which are elastomer mounted baseplate and riser pipe-guide devices, with contained double acting elastomer elements which under rated load have a minimum static deflection of 3/8 inch. Size isolator to accommodate thermal insulation within the stationary guide ring.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Ensure rails, structural steel bases, and concrete inertia blocks are raised not less than 1 inch above the floor and are level when equipment supported is under operating load.

Ensure vibration-isolation installation and deflection testing after equipment start-up is directed by a competent representative of the manufacturer.

3.2 TESTS AND REPORTS

Ensure vibration-isolation devices are deflection tested. Submit test reports in accordance with paragraph entitled, "Submittals," substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. Make all measurements in the presence of the Contracting Officer.

-- End of Section --

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203 (1990; R 2011) Field Performance
Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 62.1 (2010; Errata 2011; INT 3 2012; INT 4
2012; INT 5 2013) Ventilation for
Acceptable Indoor Air Quality

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002; 6th ed) National Standards for
Total System Balance

AABC MN-4 (1996) Test and Balance Procedures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building
and Equipment Acceptance Guide

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV (2006) Procedural Standards for
Measurements and Assessment of Sound and
Vibration

NEBB PROCEDURAL STANDARDS (2005) Procedural Standards for TAB
(Testing, Adjusting and Balancing)
Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1780 (2002) HVAC Systems - Testing, Adjusting
and Balancing, 3rd Edition

SMACNA 1858 (2013) HVAC Sound And Vibration Manual -
First Edition

SMACNA 1972 CD (2012) HVAC Air Duct Leakage Test Manual -
2nd Edition

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

40 CFR 82

Protection of Stratospheric Ozone

1.2 DEFINITIONS

- a. AABC: Associated Air Balance Council.
- b. COTR: Contracting Officer's Technical Representative.
- c. DALT: Duct air leakage test
- d. DALT'd: Duct air leakage tested
- e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.
- f. NEBB: National Environmental Balancing Bureau
- g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."
- h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.
- i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.
- j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.
- k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).
- l. TAB: Testing, adjusting, and balancing (of HVAC systems).
- m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.
- n. TAB Agency: TAB Firm
- o. TAB team field leader: TAB team field leader
- p. TAB team supervisor: TAB team engineer.

- q. TAB team technicians: TAB team assistants.
- r. TABB: Testing Adjusting and Balancing Bureau.

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of existing heating, ventilating, and cooling (HVAC) air distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB systems in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.
2. Air quantities at air terminals.
3. Air quantities and temperatures in air handling unit schedules.
4. Water quantities and temperatures in thermal energy transfer equipment schedules.
5. Water quantities and heads in pump schedules.
6. Water flow measurement fittings and balancing fittings.
7. Ductwork Construction and Leakage Testing Table that defines the DALI test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications:
<http://www.wbdg.org/ccb/NAVGRAPH/graphdoc.pdf>

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field

measurements.

1.3.4 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

Requirements for price breakdown of HVAC TAB work are specified in Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES.

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES (NAS).

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-01 Preconstruction Submittals

Records of Existing Conditions; G

TAB Firm; G

Designation of TAB team assistants; G

Designation of TAB team engineer; G

Designation of TAB team field leader; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 14 days after the approval of the TAB team engineer and/or assistant.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

DALT and TAB Work Execution Schedule; G

DALT and TAB Procedures Summary; G

Pre-Final DALT report; G

Final DALT report; G

TAB report; G

SD-07 Certificates

Independent TAB agency and personnel qualifications; G

Advance notice of Pre-Final DALT field work; G

Advance Notice of TAB Field Work; G

Completed Pre-TAB Work Checklist

TAB Firm; G

Independent TAB Agency and Personnel Qualifications; G

DALT and TAB Submittal and Work Schedule; G

Pre-field DALT preliminary notification; G

Pre-field TAB engineering report; G

Advanced notice for TAB field work; G

Prerequisite HVAC Work Check Out List; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB

supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

- b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.
- c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

- a. List all test equipment to be used, including its manufacturer, model

number, calibration date, and serial number.

- b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.
- c. Proof of equivalency if the contractor desires to substitute a test requirement.

Perform the following PTI as an integral part of the TAB process per the most recent edition of the NASA RCBEA GUIDE:

Compressors:

- a. Vibration Analysis
- b. Balance Test and Measurement
- c. Lubricating Oil Test
- d. Thermodynamic Performance Test

Fans:

- a. Vibration Analysis
- b. Balance Test and Measurement
- c. Alignment (laser preferred)
- d. Lubricating Oil Test
- e. Thermodynamic Performance Test

Heat Exchangers (Condenser Water Cooled):

- a. Hydrostatic Test
- b. Thermodynamic Performance Test

HVAC Ducts:

- a. Operational Test
- b. Ductwork Leak Testing (DALT); Pre-Final DALT report, Final DALT report

Piping Systems:

- a. Vibration Analysis
- b. Infrared Thermography

Valves:

- a. Hydrostatic Test

1.5.4 Qualifications

1.5.4.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems and building systems commissioning.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an

approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.5.4.2 TAB Specialist

The TAB Specialist must be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.4.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process specified in Section 01 91 00.00 40 COMMISSIONING.

1.5.4.4 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.5 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.5.5.1 Contractor

- a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."
- b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor,

mechanical contractor, electrical contractor, and automatic temperature controls contractor.

- c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:
 - (1) Contract drawings and specifications
 - (2) Approved submittal data for equipment
 - (3) Construction work schedule
 - (4) Up-to-date revisions and change orders for the previously listed items
- d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.
- e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.
- f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.
- g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.
- h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.
 - (1) HVAC system installations are fully complete.
 - (2) HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved

prerequisite HVAC work checklist.

- (3) DALT field checks for all systems are completed.
- (4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.
- i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.
- j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.5.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.5.3 TAB Team Supervisor

- a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.
- b. Pre-DALT/TAB meeting: Attend meeting with Contractor.
- c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
- d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.
- e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.
- f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.
- g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is

submitted.

- h. Technical assistance for DALT work.
 - (1) Technical assistance: Provide immediate technical assistance to TAB field team.
 - (2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of two 8 hour workdays duration.
- i. Final DALT report: Certify the DALT report. This certification includes the following work:
 - (1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.
 - (2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.
- j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
 - (1) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.
- k. Certified TAB report: Certify the TAB report. This certification includes the following work:
 - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
 - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
- l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.
- m. TAB Field Check: The TAB team supervisor must attend and supervise Season 1 TAB field check.

1.5.5.4 TAB Team Field Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
- c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.6 Test Reports

1.5.6.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

- a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.
- b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition, provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.
- c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.
- d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.6.2 Certified TAB Reports

Submit: TAB Report for Season 1 in the following manner:

- a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.
- b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and

outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

- (1) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.
 - (2) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Season I TAB Report.
- c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.
- e. Duct Traverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."
- f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.
- Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.
- g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.
- h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.
- i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 PROJECT/SITE CONDITIONS

1.6.1 DALT and TAB Services to Obtain Existing Conditions

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct this DALT

and TAB work in accordance with the requirements of this section.

1.7 SEQUENCING AND SCHEDULING

1.7.1 DALT and TAB Submittal and Work Schedule

Comply with additional requirements specified in Appendix C: DALT AND TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section

1.7.2 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the DALT work and TAB work must be planned, completed, and accepted for each construction phase.

1.7.2.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase in spite of the fact that there will be two seasons. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, and the DALT work, the TAB work and DALT work must be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.7.3 DALT and TAB Submittal and Work Schedule

Submit this schedule, and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of

DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit TAB report.

Pre-Field TAB Engineering Report: Within 15 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List and Advanced Notice For TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 15 calendar days after completion of TAB field work, submit TAB report.

TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work.

1.7.3.1 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.7.3.2 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

- (1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.
- (2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.
- (3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

- b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:
- (1) Design data obtained from system drawings, specifications, and approved submittals.
 - (2) Notations detailing additional data to be obtained from the contract site by the TAB field team.
 - (3) Designate the actual data to be measured in the TAB field work.
 - (4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.
- c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.8 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, stating that all contract requirements of this section must be accomplished directly by a first tier subcontractor. No work may be performed by a second tier subcontractor.

1.9 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 year from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT 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 TAB firm.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section as specified in Appendix A WORK DESCRIPTIONS OF PARTICIPANTS.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) and the designing engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the 20 percent portion specified above.

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1972 CD.

In spite of specifications of SMACNA 1972 CD to the contrary, DALT ductwork

of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

3.3.5 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-Final DALT Report data can commence.

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms. Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the CxA and COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the CxA and COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.8 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

On successful completion of all field checks of the Pre-Final DALT Report data for all systems, the TAB Supervisor shall assemble, review, approve, sign and submit the Final DALT Report in compliance with Appendix B REPORTS - DALT and TAB to the Contracting Officer for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 and AABC MN-4, NEBB PROCEDURAL STANDARDS, NEBB MASV, or SMACNA 1780 (TABB) and SMACNA 1858 (TABB), except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

- a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the

purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

- b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.3.3 Heating and Ventilating Units

Heating and ventilating unit systems including fans, coils, ducts, plenums, roof vents, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.4 Return Air Fans

Return air fan system including fan ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.5 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.4.4.2 Dual Temperature Water

Dual temperature water systems including boilers, converters, chillers, condensers, cooling towers, pumps, coils, and system balancing valves, and flow measuring devices.

3.4.5 TAB Work on Performance Tests Without Seasonal Limitations

3.4.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and dehumidification system.

3.4.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.5.3 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.5.4 Coils

Report heating and cooling performance capacity tests for hot water, and DX for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

- a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

- b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.6 TAB Work on Performance Tests With Seasonal Limitations

3.4.6.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.4.6.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for TAB field measurements. Visit the contract site during the season of maximum heating load and visit the contract site during the season of maximum cooling load, the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.

3.4.6.3 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.6.4 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.5 Coils

Report heating and cooling performance capacity tests for hot water, and DX for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

- a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

- b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.7 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within

plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.8 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.9 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - DALT and TAB

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

3.4.10 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.10.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, air motion) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All return fans and air handling units (rooftop and central stations).

Group 2: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 3: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 4: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.10.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.10.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

3.7 APPENDICES

- Appendix A WORK DESCRIPTIONS OF PARTICIPANTS
- Appendix B REPORTS - DALT and TAB
- Appendix C DALT AND TAB SUBMITTAL AND WORK SCHEDULE
- Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING

Appendix A

WORK DESCRIPTIONS OF PARTICIPANTS

The Contractor is responsible for ensuring compliance with all requirements of this specification section. However, the following delineation of specific work items is provided to facilitate and co-ordinate execution of the various work efforts by personnel from separate organizations.

1. Contractor
 - a. HVAC documentation: Provide pertinent contract documentation to the TAB Firm, to include the following: the contract drawings and specifications; copies of the approved submittal data for all HVAC equipment, air distribution devices, and air/water measuring/balancing devices; the construction work schedule; and other applicable documents requested by the TAB Firm. Provide the TAB Firm copies of contract revisions and modifications as they occur.
 - b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.
 - c. Pre-DALT and TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.
 - d. Coordinate Support: Provide and coordinate support personnel required by the TAB Firm in order to accomplish the DALT and TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.
 - e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph entitled "Construction Deficiencies." Correct each deficiency as soon as practical with the Contracting Officer, and submit revised schedules and other required documentation.
 - f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's DALT and TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

- g. Give Notice of Testing: Submit advance notice of TAB field work accompanied by completed prerequisite HVAC Work List
- h. Insulation work: Ensure that no insulation is shall not be installed

on ducts to be DALT'd until DALT work on the subject ducts is complete.

Ensure the duct and piping systems are properly insulated and vapor sealed upon the successful completion and acceptance of the DALT and TAB work.

2. TAB Team Supervisor
 - a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.
 - b. Schedule: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.
 - c. Submittals: Provide the submittals specified herein.
 - d. Pre-DALT/TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.
 - e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.
 - f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the DALT and TAB Procedures Summary, the during the DALT or TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-Final DALT and Pre-TAB Checklists are completely and successfully conducted before DALT and TAB field work is performed.

- g. Advance Notice: Monitor the completion of the duct system installations and provide the Advance Notice for Pre-Final DALT field work as specified herein.
- h. Technical Assistance: Provide technical assistance to the DALT and TAB field work.
- i. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph entitled "Construction Deficiencies." Resolve each deficiency as soon as practical and submit revised schedules and other required documentation.
- j. Procedures: Develop the required TAB procedures for systems or system

components not covered in the TAB Standard.

3. TAB Team Field Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
- c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

Appendix B

REPORTS - DALT and TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. DALT and TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. DALT and TAB Procedures Summary

Submit a detailed narrative describing all aspects of the DALT and TAB field work to be performed. Clearly distinguish between DALT information and TAB information. Include the following:

- a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.
- b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.
- c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.
- d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.
- e. A list of DALT and TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.
- f. A thorough checklist of the work items and inspections that need to be accomplished before DALT field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-Final DALT Work Checklist before DALT field work can be accomplished.
- g. A thorough checklist of the work items and inspections that need to be accomplished before the TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-TAB Work Checklist before the TAB field work can be accomplished.
- h. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to

NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

- a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
 - b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the DALT work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.
4. Pre-Final DALT Report for COTR DALT Field Checks

Report the data for the Pre-Final DALT Report meeting the following requirements:

- a. Submit a copy of the approved DALT and TAB Procedures Summary: Provide notations describing how actual field procedures differed from the procedures listed.
- b. Report format: Submit a comprehensive report for the DALT field work data using data presentation forms equivalent to the "Air Duct Leakage Test Summary Report Forms" located in the SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section.
- c. Calculations: Include a copy of all calculations prepared in determining the duct surface area of each duct test section. Include in the DALT reports copy(s) of the calibration curve for each of the DALT test orifices used for testing.
- d. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments are to be calibrated within one year of the date of use in the field; instrument calibration is to be traceable to the measuring standards of the National Institute of Standards and Technology.
- e. TAB Supervisor Approval: Include on the submitted report the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

5. Final DALT Report

On successful completion of all COTR field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, sign and submit the Final DALT Report to the Contracting Officer for approval.

6. TAB Reports: Submit TAB Report for Season 1 and TAB Report for Season 2 in the following manner:
 - a. Procedure Summary: Submit a copy of the approved DALT and TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.
 - b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.
 - c. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:
 - (1) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.
 - (2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode. Provide a detailed explanation wherever a final measurement did not achieve the required value.
 - (3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.
 - d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.
 - e. Air Static Pressure Profiles: Report static pressure profiles for air duct systems including: HVU-1, 2, 3, 4, 5, 6, 7 and HP-2. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:
 - (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

- (2) Report static pressure drop across DX coils and hot water coils installed in unit cabinetry or the system ductwork.
- (3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.
- (4) Report static pressure drop across air filters, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

- (5) Report static pressure drop across outside air and relief/exhaust air louvers.
 - (6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.
- f. Duct Transverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane".
- g. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

- h. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.
- i. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.
- j. Data From TAB Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms

shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

Appendix C

DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below. Include the major items listed in this schedule in the project network analysis schedule required by Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES (NAS).

Submit TAB Agency and TAB Personnel Qualifications: Within 42 calendar days after date of contract award.

Submit the DALT and TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule 28 days prior to commencement of DALT work and 28 days prior to the commencement of TAB Season 1 work and TAB Season 2 work.

Submit the DALT and TAB Work Procedures Summary: within 14 days after receipt of the initial approved DALT and TAB Work Execution Schedule.

Meet with the COTR at the Pre-DALT/TAB Meeting: Within 28 calendar days after receipt of the approved initial DALT/TAB Execution Schedule.

Submit Design Review Report: Within 56 calendar days after the receipt of the approved initial DALT and TAB Work Execution Schedule.

Conduct measurements and submit the Record of Existing Facility Conditions: within 28 days after receipt of approved DALT and TAB Work Procedures Summary.

Advance Notice of Pre-Final DALT Field Work: After the completed installation of the HVAC duct system to be DALT'd, submit to the Contracting Officer an Advance Notice of Pre-Final DALT Field Work accompanied by the completed Pre-Final DALT Work Checklistchecklist for the subject duct system.

Ductwork Selected for DALT: Within 14 calendar days after receiving an acceptable completed Pre-Final DALT Work Checklist, the Contracting Officer's technical representative (COTR) will select the project ductwork sections to be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected project ductwork.

Submit Pre-Final DALT Report: Within two working days after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Quality Assurance - COTR DALT Field Checks: Upon approval of the Pre-final DALT Report, the COTR's DALT field check work shall be scheduled with the Contracting Officer.

Submit Final DALT Report: Within 14 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Advance Notice of TAB Field Work: At a minimum of 14 calendar days prior to TAB Field Work, submit advance notice of TAB field work accompanied

by completed
 Pre-TAB Work Checklist.

TAB Field Work: At a minimum of 84 calendar days prior to CCD, and when the ambient temperature is within limits, accomplish TAB field work.

Submit TAB Report: Within 14 calendar days after completion of TAB field work, submit initial TAB report.

Quality Assurance - COTR TAB Field Check: 30 calendar days after initial TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from Contracting Officer approved TAB report.

Appendix D									
REQUIREMENTS FOR DUCT AIR LEAK TESTING									
SYSTEMS									
		HVU-1	HVU-2	HVU-3	HVU-4	HVU-5	HVU-6	HVU-7	HP-2
Duct System Static Pressure in inches W.C.	for Supply	2"	2"	2"	2"	2"	2"	2"	2"
System Oval/Round Duct and Rectangular Duct SMACNA Seal Class	for Supply	A	A	A	A	A	A	A	A

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
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. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP (2010; ERTA 2011-2013) Energy Standard for
Buildings Except Low-Rise Residential
Buildings

ASTM INTERNATIONAL (ASTM)

ASTM B209 (2014) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM C1710 (2011) Standard Guide for Installation of
Flexible Closed Cell Preformed Insulation
in Tube and Sheet Form

ASTM C195 (2007; R 2013) Standard Specification for
Mineral Fiber Thermal Insulating Cement

ASTM C450 (2008) Standard Practice for Fabrication
of Thermal Insulating Fitting Covers for
NPS Piping, and Vessel Lagging

ASTM C552 (2014) Standard Specification for Cellular
Glass Thermal Insulation

ASTM C612 (2014) Mineral Fiber Block and Board
Thermal Insulation

ASTM C795 (2008; R 2013) Standard Specification for
Thermal Insulation for Use in Contact with
Austenitic Stainless Steel

ASTM C916 (1985; R 2007) Standard Specification for
Adhesives for Duct Thermal Insulation

ASTM C920 (2014a) Standard Specification for
Elastomeric Joint Sealants

ASTM C921 (2010) Standard Practice for Determining
the Properties of Jacketing Materials for

Thermal Insulation

ASTM D5590 (2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

ASTM E2231 (2014) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

ASTM E84 (2014) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M (2013) Standard Test Methods for Water Vapor Transmission of Materials

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2758 (2014) Paper - Determination of Bursting Strength

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

MSS SP-69 (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds (1999) National Commercial & Industrial Insulation Standards

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM (2010) Bursting Strength of Paper

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-24179 (1969; Rev A; Am 2 1980; Notice 1 1987) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

MIL-A-3316 (1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 723 (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials

UL 94 (2013; Reprint Jul 2014) Standard for
Tests for Flammability of Plastic
Materials for Parts in Devices and
Appliances

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.2.2 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet all other requirements of this section. The minimum recycled material content of the following insulation are:

Rock Wool	75 percent slag of weight
Fiberglass	20-25 percent glass cullet by weight
Rigid Foam	9 percent recovered 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

Pipe Insulation Systems and Associated Accessories
Duct Insulation Systems and Associated Accessories

SD-03 Product Data

Pipe Insulation Systems; G
Duct Insulation Systems; G

SD-04 Samples

Thermal Insulation; G

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G
Duct Insulation Systems; G

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers 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 a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Insulation shall be CFC and HCFC free.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to ASTM E2231.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 - IP. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Jackets

2.2.7.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.7.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.7.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.8 Vapor Retarder Required

2.2.8.1 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM or ISO 2758. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.9 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.10 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3 PIPE INSULATION SYSTEMS

Insulation thickness shall be 1 inch. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.1.1 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.1 - IP.

2.4.2 Duct Insulation Jackets

2.4.2.1 Metal Jackets

2.4.2.1.1 Aluminum Jackets

ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified on Mechanical Drawings. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned

prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.2.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.2.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.3 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.4 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline

systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.
- e. Adjacent insulation.
- f. ASME stamps.
- g. Access plates of fan housings.
- h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.2.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-69, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.2.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.2 Aboveground Hot Pipelines

3.2.2.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated. This includes but is not limited to the following:

- a. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.2.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

3.2.2.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.2.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0

Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

- a. Supply ducts.
- b. Return air ducts.
- c. Relief ducts.
- d. Plenums.
- e. Duct-mounted coil casings.
- f. Coil headers and return bends.
- g. Coil casings.
- h. Fresh air intake ducts.
- i. Filter boxes.
- j. Mixing boxes (field-insulated).
- k. Supply fans (field-insulated).
- l. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and

grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.
- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.
- b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.
- c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.
- d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.
- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

- a. Supply ducts.
- b. Return air ducts.

- c. Relief air ducts
- d. Flexible run-outs (field insulated).
- e. Plenums.
- f. Fresh air intake ducts.
- g. Filter boxes.
- h. Mixing boxes.
- i. Supply fans.
- n. Ducts exposed to weather.

Insulation for rectangular ducts shall be rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

- a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.
- f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

- a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from

the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

- b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.
- d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.
- e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.
- f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.
- g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.6 Duct Exposed to Weather

3.3.6.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.6.2 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.6.3 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws or vapor barrier/weatherproofing jacket less than 0.0000 permeability greater than 3 ply, standard grade, silver, white, black, and embossed or greater than 8 ply, heavy duty white and natural. Membrane shall be applied overlapping material by 3 inches. No bands or caulking needed-see manufacturing recommended installation instructions.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

- a. Hand-holes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.
- f. Duct Test/Balance Test Holes.

3.4.2 Equipment Exposed to Weather

3.4.2.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

-- End of Section --

SECTION 23 09 23.13 20

BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC
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 in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D (2012) Laboratory Methods of Testing
Dampers for Rating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 135 (2012; Errata 1 2013; INT 1-9 2013; Errata
2 2013; INT 10-12 2014; Errata 3 2014)
BACnet-A Data Communication Protocol for
Building Automation and Control Networks

ARCNET TRADE ASSOCIATION (ATA)

ATA 878.1 (1999) Local Area Network: Token Bus

ASME INTERNATIONAL (ASME)

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings:
NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B31.1 (2014; INT 1-47) Power Piping

ASME B40.100 (2013) Pressure Gauges and Gauge
Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A126 (2004; R 2014) Standard Specification for
Gray Iron Castings for Valves, Flanges,
and Pipe Fittings

ASTM B117 (2011) Standard Practice for Operating
Salt Spray (Fog) Apparatus

CONSUMER ELECTRONICS ASSOCIATION (CEA)

CEA-709.1-D (2014) Control Network Protocol
Specification

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

IEEE C62.45 (2002; R 2008) Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000v and less)AC Power Circuits

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 8802-3 (2000) Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD)Access Method and Physical Layer Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966 (2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

UNDERWRITERS LABORATORIES (UL)

UL 1449 (2014) Surge Protective Devices

UL 506 (2008; Reprint Oct 2013) Specialty Transformers

UL 508A (2013; Reprint Jan 2014) Industrial Control Panels

UL 916 (2007; Reprint Aug 2014) Standard for Energy Management Equipment

1.2 DEFINITIONS

1.2.1 ANSI/ASHRAE Standard 135

ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks, referred to as "BACnet". ASHRAE developed BACnet to provide a method for diverse building automation devices to communicate and share data over a network.

1.2.2 ARCNET

ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it's possible to determine the maximum delay before a device is able to transmit a message.

1.2.3 BACnet

Building Automation and Control Network; the common name for the communication standard ASHRAE 135. The standard defines methods and protocol for cooperating building automation devices to communicate over a variety of LAN technologies.

1.2.4 BACnet/IP

An extension of BACnet, Annex J, defines this mechanism using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number. See also "BACnet Broadcast Management Device".

1.2.5 BACnet Internetwork

Two or more BACnet networks, possibly using different LAN technologies, connected with routers. In a BACnet internetwork, there exists only one message path between devices.

1.2.6 BACnet Network

One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.

1.2.7 BACnet Segment

One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.

1.2.8 BBMD

BACnet Broadcast Management Device (BBMD). A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Every IP subnetwork that is part of a BACnet/IP network must have only one BBMD. See also "BACnet/IP".

1.2.9 BAS

Building Automation Systems, including DDC (Direct Digital Controls) used for facility automation and energy management.

1.2.10 BAS Owner

The regional or local user responsible for managing all aspects of the BAS operation, including: network connections, workstation management, submittal review, technical support, control parameters, and daily operation. The BAS Owner for this project is NAVFAC Midlant.

1.2.11 BIBBs

BACnet Interoperability Building Blocks. A collection of BACnet services

used to describe supported tasks. BIBBs are often described in terms of "A" (client) and "B" (server) devices. The "A" device uses data provided by the "B" device, or requests an action from the "B" device.

1.2.12 BI

BACnet International, formerly two organizations: the BACnet Manufacturers Association (BMA) and the BACnet Interest Group - North America (BIG-NA).

1.2.13 BI/BTL

BACnet International/BACnet Testing Laboratories (Formerly BMA/BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

1.2.14 Bridge

Network hardware that connects two or more network (or BACnet internetwork) segments at the physical and data link layers. A bridge may also filter messages.

1.2.15 Broadcast

A message sent to all devices on a network segment.

1.2.16 Device

Any control system component, usually a digital controller, that contains a BACnet Device Object and uses BACnet to communicate with other devices. See also "Digital Controller".

1.2.17 Device Object

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

1.2.18 Device Profile

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE Standard 135-2004, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing BIBBs supported.

1.2.19 Digital Controller

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions. In most cases, synonymous with a BACnet device described in this specification. See also "Device".

1.2.20 Direct Digital Control (DDC)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal

programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.2.21 DDC System

A network of digital controllers, communication architecture, and user interfaces. A DDC system may include programming, sensors, actuators, switches, relays, factory controls, operator workstations, and various other devices, components, and attributes.

1.2.22 Ethernet

A family of local-area-network technologies providing high-speed networking features over various media.

1.2.23 Firmware

Software programmed into read only memory (ROM), flash memory, electrically erasable programmable read only memory (EEPROM), or erasable programmable read only memory (EPROM) chips.

1.2.24 Gateway

Communication hardware connecting two or more different protocols, similar to human language translators. The Gateway translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

1.2.25 Half Router

A device that participates as one partner in a BACnet point-to-point (PTP) connection. Two half-routers in an active PTP connection combine to form a single router.

1.2.26 Hub

A common connection point for devices on a network.

1.2.27 Internet Protocol (IP, TCP/IP, UDP/IP)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.2.28 Input/Output (I/O)

Physical inputs and outputs to and from a device, although the term sometimes describes software, or "virtual" I/O. See also "Points".

1.2.29 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller.

1.2.30 IP subnet

Internet protocol (IP) identifies individual devices with a 32-bit number divided into four groups from 0 to 255. Devices are often grouped and share some portion of this number. For example, one device has IP address 209.185.47.68 and another device has IP address 209.185.47.82. These two devices share Class C subnet 209.185.47.00

1.2.31 Local-Area Network (LAN)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.2.32 LonTalk

CEA-709.1-D. A communication protocol developed by Echelon Corp. LonTalk is an optional physical and data link layer for BACnet.

1.2.33 MAC Address

Media Access Control address. The physical node address that identifies a device on a Local Area Network.

1.2.34 Master-Slave/Token-Passing (MS/TP)

ISO 8802-3. One of the LAN options for BACnet. MSTP uses twisted-pair wiring for relatively low speed and low cost communication (up to 4,000 ft at 76.8K bps).

1.2.35 Native BACnet Device

A device that uses BACnet as its primary, if not only, method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

1.2.36 Network

Communication technology for data communications. BACnet approved network types are BACnet over Internet Protocol (IP), Point to Point (PTP) Ethernet, ARCNET, MS/TP, and LonTalk®.

1.2.37 Network Number

A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

1.2.38 Object

The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

1.2.39 Object Identifier

An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

1.2.40 Object Properties

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.2.41 Peer-to-Peer

Peer-to-peer refers to devices where any device can initiate and respond to communication with other devices.

1.2.42 Performance Verification Test (PVT)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.2.43 PID

Proportional, integral, and derivative control; three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.2.44 PICS

Protocol Implementation Conformance Statement (PICS), describing the BACnet capabilities of a device. See BACnet, Annex A for the standard format and content of a PICS statement.

1.2.45 Points

Physical and virtual inputs and outputs. See also "Input/Output".

1.2.46 PTP

Point-to-Point protocol connects individual BACnet devices or networks using serial connections like modem-to-modem links.

1.2.47 Repeater

A network component that connects two or more physical segments at the physical layer.

1.2.48 Router

A BACnet router is a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

1.2.49 Stand-Alone Control

Refers to devices performing equipment-specific and small system control without communication to other devices or computers for physical I/O, excluding outside air and other common shared conditions. Devices are located near controlled equipment, with physical input and output points limited to 64 or less per device, except for complex individual equipment or systems. Failure of any single device will not cause other network

devices to fail. BACnet "Smart" actuators (B-SA profile) and sensors (B-SS profile) communicating on a network with a parent device are exempt from stand-alone requirements.

1.3 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.4 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC DESCRIPTION

- a. Remove existing and provide new BACnet DDC systems including associated equipment and accessories for data terminal cabinet. All new devices are accessible using a Web browser interface and communicate using ASHRAE 135 BACnet communications without the use of gateways, unless gateways are shown on the design drawings and specifically requested by the Government. Where gateways are allowed, they must support ASHRAE 135, including all object properties and read-write services shown on Government approved interoperability schedules. Manufacturer's products, including design, materials, fabrication, assembly, inspection, and testing shall be in accordance with ASHRAE 135, ASME B31.1, and NFPA 70, except where indicated otherwise.
- b. For HP-2/HPD-2 upgrade, tie components into existing Siemens Control System.

1.4.1 Design Requirements

1.4.1.1 Control System Drawings Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

1.4.1.2 List of I/O Points

Also known as a Point Schedule, provide for each input and output point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Binary Output (BO), Binary Input (BI)), point sensor range, point actuator range, point address, BACnet object, associated BIBBS (where applicable), and point connection terminal number. Typical schedules for multiple identical equipment are allowed unless otherwise requested in design or contract criteria.

1.4.1.3 Control System Components List

Provide a complete list of control system components installed on this project. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, and manufacturer part number. For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name,

spring or non-spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.4.1.4 Control System Schematics

Provide control system schematics. Typical schematics for multiple identical equipment are allowed unless otherwise requested in design or contract criteria. Include the following:

- a. Location of each input and output device
- b. Flow diagram for each piece of HVAC equipment
- c. Name or symbol for each control system component, such as V-1 for a valve
- d. Setpoints, with differential or proportional band values
- e. Written sequence of operation for the HVAC equipment
- f. Valve and Damper Schedules, with normal (power fail) position

1.4.1.5 HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required electrical interlocks.

1.4.1.6 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and output device. Indicate how each device is wired and powered; showing typical connections at the digital controller and power supply. Show for all field connected devices such as control relays, motor starters, actuators, sensors, and transmitters.

1.4.1.7 Terminal Strip Diagrams

Provide a diagram of each terminal strip. Indicate the terminal strip location, termination numbers, and associated point names.

1.4.1.8 BACnet Communication Architecture Schematic

Provide a schematic showing the project's entire BACnet communication network, including addressing used for LANs, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

1.5 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

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.

SD-02 Shop Drawings

Include the following in the project's control system drawing set:

Control system drawings title sheet; G

List of I/O Points; G

Control System Components List; G

Control system schematics; G

HVAC Equipment Electrical Ladder diagrams; G

Component wiring diagrams; G

Terminal strip diagrams; G

BACnet communication architecture schematic; G

SD-03 Product Data

Direct Digital Controllers; G

Include BACnet PICS for each controller/device type, including smart sensors (B-SS) and smart actuators (B-SA).

Include BACnet and workstation display information; bi-directional communication ability; compliance with interoperability schedule; expansion capacity; handling of alarms, events, scheduling and trend data; and single device capability (not depending on multiple devices for exchanging information from either side of the gateway).

BACnet Protocol Analyzer; G

Include capability to store and report data traffic on BACnet networks, measure bandwidth usage, filter information, and identify BACnet devices.

BACnet Operator Workstation DDC Software; G

Include BACnet PICS for Operator Workstation software.

Sensors and Input Hardware; G

Output Hardware; G

Surge and transient protection; G

Indicators; G

SD-05 Design Data

Performance Verification Testing Plan; G

Pre-Performance Verification Testing Checklist; G

SD-06 Test Reports

Performance Verification Testing Report; G

SD-09 Manufacturer's Field Reports

Pre-PVT Checklist; G

SD-10 Operation and Maintenance Data

Comply with requirements for data packages in Section 01 78 23
OPERATION AND MAINTENANCE DATA, except as supplemented and
modified in this specification.

BACnet Direct Digital Control Systems, Data Package 4; G

Controls System Operators Manuals, Data Package 4; G

SD-11 Closeout Submittals

Training documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

Provide material and equipment that are standard manufacturer's products currently in production and supported by a local service organization.

1.6.2 Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before and during installation according to manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6.3 Operating Environment

Protect components from humidity and temperature variation, dust, and contaminants. If components are stored before installation, keep them within the manufacturer's limits.

1.6.4 Finish of New Equipment

New equipment finishing shall be factory provided. Manufacturer's standard factory finishing shall be proven to withstand 125 hours in a salt-spray fog test. Equipment located outdoors shall be proven to withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be according to ASTM B117, with acceptance criteria as follows: immediately after completion of the test, the finish shall show no signs of degradation or loss of adhesion beyond 0.125 inch on either side of the scratch mark.

1.6.5 Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing work.

1.6.6 Contractor's Qualifications

Submit documentation certifying the controls Contractor performing the work

has completed at least three DDC systems installations of a similar design to this project, and programmed similar sequences of operation for at least two years.

1.6.7 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.6.8 Project Sequence

The control system work for this project shall proceed in the following order:

- a. Submit and receive approval on the Shop Drawings, Product Data, and Certificates specified under the paragraph entitled "SUBMITTALS."
- b. Perform the control system installation work, including all field check-outs and tuning.
- c. Provide support to TAB personnel as specified under the paragraph "TEST AND BALANCE SUPPORT."
- d. Submit and receive approval of the Controls System Operators Manual specified under the paragraph "CONTROLS SYSTEM OPERATORS MANUALS."
- e. Submit and receive approval of the Performance Verification Testing Plan and the Pre-PVT Checklist specified under the paragraph "PERFORMANCE VERIFICATION TESTING."
- f. Perform the Performance Verification Testing.
- g. Submit and receive approval on the PVT Report.
- h. Submit and receive approval on the Training Documentation specified under the paragraph "INSTRUCTION TO GOVERNMENT PERSONNEL". Submit at least 30 days before training.
- i. Deliver the final Controls System Operators Manuals.
- j. Conduct the Phase I Training on-site/hands-on training.
1. Submit and receive approval of Closeout Submittals.

PART 2 PRODUCTS

2.1 DDC SYSTEM

- a. Provide a networked DDC system for stand-alone control in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the sequence of control. Provide BACnet communications between the DDC system and native BACnet devices furnished with HVAC equipment. Devices provided shall be certified in the BACnet Testing Laboratories (BTL) Product Listing.
- b. Provide an operator workstation with complete interface software

capable of programming, configuring, and monitoring the digital controllers. The server and workstation are located at the third floor instructor station.

2.1.1 Direct Digital Controllers

Direct digital controllers shall be UL 916 rated.

2.1.1.1 I/O Point Limitation

The total number of I/O hardware points used by a single stand-alone digital controller, including I/O expansion units, shall not exceed 64, except for complex individual equipment or systems. Place I/O expansion units in the same cabinet as the digital controller.

2.1.1.2 Environmental Limits

Controllers shall be suitable for, or placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

2.1.1.3 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.4 Internal Clock

Provide internal clocks for all BACnet Building Controllers (B-BC) and BACnet Advanced Application Controllers (B-AAC) using BACnet time synchronization services. Automatically synchronize system clocks daily from an operator-designated controller. The system shall automatically adjust for daylight saving time.

2.1.1.5 Memory

Provide sufficient memory for each controller to support the required control, communication, trends, alarms, and messages. Protect programs residing in memory with EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply). The backup power source shall have capacity to maintain the memory during a 72-hour continuous power outage. Rechargeable power sources shall be constantly charged while the controller is operating under normal line power. Batteries shall be replaceable without soldering. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long.

2.1.1.6 Immunity to Power Fluctuations

Controllers shall operate at 90 percent to 110 percent nominal voltage rating.

2.1.1.7 Transformer

The controller power supply shall be fused or current limiting and rated at 125 percent power consumption.

2.1.1.8 Wiring Terminations

Use screw terminal wiring terminations for all field-installed

controllers. Provide field-removable modular terminal strip or a termination card connected by a ribbon cable for all controllers other than terminal units.

2.1.1.9 Input and Output Interface

Provide hard-wired input and output interface for all controllers as follows:

- a. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with sources up to 24 volts AC or DC for any duration shall cause no controller damage.
- b. Binary Inputs: Binary inputs shall have a toggle switch and monitor on and off contacts from a "dry" remote device without external power, and external 5-24 VDC voltage inputs.
- c. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and accumulate pulses at a resolution suitable to the application.
- d. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 VDC), current (4-20 mA), or resistance (thermistor or RTD) signals.
- e. Binary Outputs: Binary outputs shall have a toggle switch and send a pulsed 24 VDC low-voltage signal for modulation control, or provide a maintained open-closed position for on-off control. For HVAC equipment and plant controllers, provide for manual overrides, either with three-position (on-off-auto) override switches and status lights, or with an adjacent operator display and interface. Where appropriate, provide a method to select normally open or normally closed operation.
- f. Analog Outputs: Analog outputs shall send modulating 0-10 VDC or 4-20 mA signals to control output devices.
- g. Tri-State Outputs: Tri-State outputs shall provide three-point floating control of terminal unit electronic actuators.

2.1.1.10 Digital Controller BACnet Internetwork

Provide a BACnet internetwork with control products, communication media, connectors, repeaters, hubs, and routers. Provide intermediate gateways, only when requested by the Government and shown on the contract drawings, to connect existing non-BACnet devices to the BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE 135, BACnet. If a controller becomes non-responsive, the remaining controllers shall continue operating and not be affected by the failed controller.

2.1.1.11 Communications Ports

- a. Direct-Connect Interface Ports: Provide at least one extra communication port at each local BACnet network for direct connecting a notebook computer or BACnet hand-held terminal so all network BACnet objects and properties may be viewed and edited by the operator.
- b. Telecommunications Interface Port: Provide one telecommunication port per building, permitting remote communication via point-to-point (PTP) protocol over telephone lines.

2.1.1.12 Modems

Provide v.92 or DSL modems where required for communication between the BACnet Operator Workstation (B-OWS) and the DDC system.

2.1.1.13 Digital Controller Cabinet

Provide each digital controller in a factory fabricated cabinet enclosure. Cabinets located indoors shall protect against dust and have a minimum NEMA 1 rating, except where indicated otherwise. Cabinets located outdoors or in damp environments shall protect against all outdoor conditions and have a minimum NEMA 4 rating. Outdoor control panels and controllers must be able to withstand extreme ambient conditions, without malfunction or failure, whether or not the controlled equipment is running. If necessary, provide a thermostatically controlled panel heater in freezing locations, and an internal ventilating fan in locations exposed to direct sunlight. Cabinets shall have a hinged lockable door and an offset removable metal back plate, except controllers integral with terminal units, like those mounted on VAV boxes. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock.

2.1.1.14 Main Power Switch and Receptacle

Provide each control cabinet with a main external power on/off switch located inside the cabinet. Also provide each cabinet with a separate 120 VAC duplex receptacle.

2.1.2 DDC Software

2.1.2.1 Programming

Provide programming to execute the sequence of operation indicated. Provide all programming and tools to configure and program all controllers. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation.

- a. Graphic-based programming shall use a library of function blocks made from pre-programmed code designed for BAS control. Function blocks shall be assembled with interconnecting lines, depicting the control sequence in a flowchart. If providing a computer with device programming tools as part of the project, graphic programs shall be viewable in real time showing present values and logical results from each function block.
- b. Menu-based programming shall be done by entering parameters, definitions, conditions, requirements, and constraints.
- c. For line-by-line and text-based programming, declare variable types (local, global, real, integer, etc.) at the beginning of the program. Use descriptive comments frequently to describe the programming.
- d. If providing a computer with device programming tools as part of the project, provide a means for detecting program errors and testing software strategies with a simulation tool. Simulation may be inherent within the programming software suite, or provided by physical controllers mounted in a NEMA 1 test enclosure. The test enclosure

shall contain one dedicated controller of each type provided under this contract, complete with power supply and relevant accessories.

2.1.2.2 Parameter Modification

All writeable object properties, and all other programming parameters needed to comply with the project specification shall be adjustable for devices at any network level, including those accessible with web-browser communication, and regardless of programming methods used to create the applications.

2.1.2.3 Short Cycling Prevention

Provide setpoint differentials and minimum on/off times to prevent equipment short cycling.

2.1.2.4 Equipment Status Delay

Provide an adjustable delay from when equipment is commanded on or off and when the control program looks to the status input for confirmation.

2.1.2.5 Run Time Accumulation

Use the Elapsed Time Property to provide re-settable run time accumulation for each Binary Output Object connected to mechanical loads greater than 1 HP, electrical loads greater than 10 KW, or wherever else specified.

2.1.2.6 Timed Local Override

Provide an adjustable override time for each push of a timed local override button.

2.1.2.7 Time Synchronization

Provide time synchronization, including adjustments for leap years, daylight saving time, and operator time adjustments.

2.1.2.8 Scheduling

Provide operating schedules as indicated, with equipment assigned to groups. Changing the schedule of a group shall change the operating schedule of all equipment in the group. Groups shall be capable of operator creation, modification, and deletion. Provide capability to view and modify schedules in a seven-day week format. Provide capability to enter holiday and override schedules one full year at a time.

2.1.2.9 Object Property Override

Allow writeable object property values to accept overrides to any valid value. Where specified or required for the sequence of control, the Out-Of-Service property of Objects shall be modifiable using BACnet's write property service. When documented, exceptions to these requirement are allowed for life, machine, and process safeties.

2.1.2.10 Alarms and Events

Alarms and events shall be capable of having programmed time delays and high-low limits. When a computer workstation or web server is connected to the BACnet internetwork, alarms/events shall report to the computer,

printer, e-mail or cell phone, as defined by an authorized operator. Otherwise alarms/events shall be stored within a device on the BACnet network until connected to a user interface device and retrieved. Provide alarms/events in agreement with the point schedule, sequence of operation, and the BAS Owner. At a minimum, provide programming to initiate alarms/events any time a piece of equipment fails to operate, a control point is outside normal range or condition shown on schedules, communication to a device is lost, a device has failed, or a controller has lost its memory.

2.1.2.11 Trending

Provide BACnet trend services capable of trending all object present values set points, and other parameters indicated for trending on project schedules. Trends may be associated into groups, and a trend report may be set up for each group. Trends are stored within a device on the BACnet network, with operator selectable trend intervals from 10 seconds up to 60 minutes. The minimum number of consecutive trend values stored at one time shall be 100 per variable. When trend memory is full, the most recent data shall overwrite the oldest data.

The operator workstation shall upload trends automatically upon reaching 3/4 of the device buffer limit (via Notification_Threshold property), by operator request, or by time schedule for archiving. Archived and real-time trend data shall be available for viewing numerically and graphically for at the workstation and connected notebook computers.

2.1.2.12 Device Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and device fault condition. The DDC system shall recognize and report a non-responsive controller.

2.1.2.13 Power Loss

Upon restoration of power, the DDC system shall perform an orderly restart and restoration of control.

2.1.3 BACnet Operator Workstation

The workstation shall be capable of accessing all DDC system devices and communicate using the BACnet protocol. The workstation shall be capable of displaying, modifying, creating, archiving, and deleting (as applicable): all points, objects, object properties, programming, alarms, trends, messages, schedules, and reports.

2.1.3.1 BACnet Operator Workstation Hardware

Configure according to system manufacturer's specifications and conforming to BACnet Operator Workstation (B-OWS) device standards found in ASHRAE 135, Annex L. Install to permit complete monitoring and troubleshooting of the DDC system.

At a minimum the workstation hardware shall include: a desktop personal computer with Microsoft Windows 8 operating system or equal, processor and RAM exceeding capability and speed required by operating system and application software, hard drive capacity exceeding software and yearly archive requirements, 16X internal DVD+/-R/RW/CD-RW drive with archive creator software, internal 400 GB hard drive and cable, 4 USB 2.0 ports,

10/100 network interface card, MS/TP card, minimum 40-inch LCD monitor, internal V.92 modem, sound card with speakers, 101 character keyboard, optical mouse, USB Hub with four USB 2.0 ports and connecting cable, laser printer with USB port and cable, 3 matching toner cartridges, 120-volt 800 VA uninterruptible power supply with automatic voltage regulation and 4 minimum battery back-up outlets and 2 surge protected outlets, Microsoft Office bundled software, and Symantec Ghost disk imaging software or equal. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide a manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner. An additional 50-inch monitor to be provided and wall mounted. Coordinate final location with Owner.

2.1.3.2 Password Protection

Provide at least five levels of password protection for operator interfaces. The lowest level only allow viewing graphics. The second level allows viewing graphics and changing space temperature setpoints. The third level allows the previous level's capability, plus changing operating schedules. The fourth level allows access to all functions except passwords. The highest level provides all administrator rights and allows full access to all programming, including setting new passwords and access levels. Provide the BAS Owner with the highest level password access. Provide automatic log out if no keyboard or mouse activity is detected after a user-defined time delay.

2.1.3.3 BACnet Operator Workstation DDC Software

Provide the workstation software with the manufacturer's installation CDs and licenses. Configure the software according to the DDC system manufacturer's specifications and in agreement with BACnet Operator Workstation (B-OWS) device standards found in ASHRAE 135, Annex L.

The workstation software shall permit complete monitoring, modification, and troubleshooting interface with the DDC system. The operator interface with the software shall be menu-driven with appropriate displays and menu commands to manipulate the DDC system's objects, point data, operating schedules, control routines, system configuration, trends, alarms, messages, graphics, and reports. Trends shall be capable of graphic display in real time, with variables plotted as functions of time. Each alarmed point shall be capable of displaying its alarm history, showing when it went into alarm, if and when it was acknowledged, and when it went out of alarm. The modification of DDC system parameters and object properties shall be accomplished with "fill in the blank" and/or "point and drag" methods. Modifications shall download to the appropriate controllers at the operator's request.

2.1.3.4 Graphics Software

Provide web-based system graphics viewable on browsers compatible with MS Internet Explorer 6.X or greater using an industry-standard file format such as HTML, BMP, JPEG, or GIF.

Graphic displays shall have full-screen resolution when viewed on the workstation and notebook computers. Dynamic data on graphics pages shall refresh within 10 seconds using an Internet connection, or 30 seconds using a dial-up modem connection. Graphics viewing shall not require additional "plug-in" software like Java, Shockwave and Flash applications unless the software is readily available for free over the Internet, and certified for

use with Navy Marine Corps Internet (NMCI) personal computers.

The graphics shall show the present value and object name for each of the project's I/O points on at least one graphic page. Arrange point values and names on the graphic displays in their appropriate physical locations with respect to the floor plan or equipment graphic displayed. Graphics shall allow the operator to monitor current status, view zone and equipment summaries, use point-and-click navigation between graphic pages, and edit setpoints and parameters directly from the screens. Items in alarm shall be displayed using a different color or other obvious visual indicator. Provide graphics with the following:

- a. Graphic Types: Provide at least one graphic display for each piece of HVAC equipment, building floor, and controlled zone. Indicate dynamic point values, operating statuses, alarm conditions, and control setpoints on each display. Provide summary pages where appropriate.
 - (1) Building Elevation: For buildings more than one story, provide an elevation view of the building with links to each of the building's floor plans. Simulate the building's architecture and include the building number and floor numbers. If possible, use an actual photograph of the building.
 - (2) Building Floor Plans: Provide a floor plan graphic for each of the building's floors and roof with dynamic display of space temperature and other important data. If used, indicate and provide links to sub-plan areas. If possible, use the project's electronic drawing files for the graphic backgrounds. Provide clear names for important areas, such as "Main Conference Room." Include room names and numbers where applicable. Include features such as stairwells, elevators, and main entrances. Where applicable, include the mechanical room, HVAC equipment, and control component locations, with corresponding links to the equipment graphics.
 - (3) Sub-plan Areas: Where a building's floor plan is too large to adequately display on the screen, sub-divide the plan into distinct areas, and provide a separate graphic display for each area. Provide same level of detail requested in building floor plan section above.
 - (4) HVAC Equipment: Provide a graphic display for each piece of HVAC equipment, such as a fan coil unit, VAV terminal, or air handling unit. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as a central chiller plant or central heating plant, provide one graphic to depict the entire plant. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, dampers, and control valves. Show the direction of air and water flow. Include dynamic display of applicable object data with clear names in appropriate locations.
 - (5) Sequence of Operation: Provide a graphic screen displaying the written out full sequence of operation for each piece of HVAC equipment. Provide a link to the sequence of operation displays on their respective equipment graphics. Include dynamic real-time data within the text for setpoints and variables.

- b. Graphic Title: Provide a prominent, descriptive title on each graphic page.
- c. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.
- d. Graphic Linking: Provide forward and backward linking between floor plans, sub-plans, and equipment.
- e. Graphic Editing: Provide installed software to create, modify, and delete the DDC graphics. Include the ability to store graphic symbols in a symbol directory and import these symbols into the graphics.
- f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on the graphics.

2.1.4 Desktop Computer

Provide a desktop computer, complete with the project's installed DDC software, applications database, and graphics to fully troubleshoot and program the project's devices. Notebook computers for web-based systems do not require this installed software if they have the ability to connect locally in real time, view all graphics, and fully troubleshoot, modify, and program all project devices. Provide the desktop computer with all necessary cables and interface hardware needed for setup and communication with the controllers and control system components.

At a minimum the desktop computer shall include: a Microsoft Windows 8 operating system, processor with capability and speed required by application software, 400 giga-byte hard drive, 4GB RAM, 2 USB 2.0 ports, 10/100 network interface card, MS/TP card, internal modem, 19-inch display, keyboard, DVD + RW/CD-RW Drive, and Microsoft Office bundled software. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide the manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner.

2.1.5 BACnet Protocol Analyzer

Provide a BACnet protocol analyzer and required cables and fittings for connection to the BACnet network. The analyzer shall include the following minimum capabilities:

- a. Capture and store to a file data traffic on all network levels.
- b. Measure bandwidth usage.
- c. Filtering options with ability to ignore select traffic.

2.2 SENSORS AND INPUT HARDWARE

Coordinate sensor types with the BAS Owner to keep them consistent with existing installations.

2.2.1 Field-Installed Temperature Sensors

Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.

2.2.1.1 Thermistors

Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F.

2.2.1.3 Temperature Sensor Details

- a. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor.
- b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.
- c. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 feet.
- d. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.
- e. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.

2.2.2 Transmitters

Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

2.2.2.1 Relative Humidity Transmitters

Provide transmitters with an accuracy equal to plus or minus 3 percent from 0 to 90 percent scale, and less than one percent drift per year. Sensing elements shall be the polymer type.

2.2.2.2 Pressure Transmitters

Provide transmitters integral with the pressure transducer.

2.2.3 Current Transducers

Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.

2.2.4 Pneumatic to Electric Transducers

Pneumatic to electronic transducers shall convert a 0 to 20 psig signal to a proportional 4 to 20 mA or 0 to 10 VDC signal (operator scaleable). Supply voltage shall be 24 VDC. Accuracy and linearity shall be 1.0 percent or better.

2.2.5 Air Quality Sensors

Provide power supply for each sensor.

2.2.5.1 CO2 Sensors

Provide photo-acoustic type CO2 sensors with integral transducers and linear output. The devices shall read CO2 concentrations between 0 and 2000 ppm with full scale accuracy of at least plus or minus 100 ppm.

2.2.5.2 Air Quality Sensors

Provide full spectrum air quality sensors using a hot wire element based on the Taguchi principle. The sensor shall monitor a wide range of gaseous volatile organic components common in indoor air contaminants like paint fumes, solvents, cigarette smoke, and vehicle exhaust. The sensor shall automatically compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC, and have a service rating of 32 to 140 degrees F and 5 to 95 percent relative humidity.

2.2.5.3 Chlorine Sensors

Range: 0-10 PPM
Output signal range: 4-20 mA
Digital output signal: RS-485 Modbus RTU
Power supply: 10-30 V
Response time: <60 seconds
Operating temperature: -20 deg. C to +50 deg. C
Enclosure: weather proof, SS

2.2.5.4 Propane Sensors

Range: 0-100% LEL (lower explosive limit)
Accuracy: +/- 3% 0-50% LEL, +/-5% 51-100% LEL
Output signal range: 4-20 mA
Digital output signal: RS-485 Modbus RTU

Power supply: 10-30 V
Response time: T90 <15 seconds
Operating temperature: -40 deg. C to +55 deg. C
Enclosure: Weatherproof, SS

2.2.6 Input Switches

2.2.6.1 Timed Local Overrides

Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24 hour continuous operation.

2.2.7 Freeze Protection Thermostats

Provide special purpose thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 40 square feet. Provide longer elements for larger coils at 1-foot of element for every 4 square feet of coil face area, or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

2.3 OUTPUT HARDWARE

2.3.1 Control Dampers

Provide factory manufactured stainless steel dampers where indicated. Control dampers shall comply with SMACNA 1966 except as modified or supplemented by this specification. Published damper leakage rates and respective pressure drops shall have been verified by tests in compliance with AMCA 500-D requirements.

Provide damper assembly frames constructed of 0.064 inch minimum thickness stainless steel channels with mitered and welded corners. Damper axles shall be 0.5 inches minimum diameter plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings.

Dampers shall be rated for not less than 2000 fpm air velocity. The pressure drop through each damper when full-open shall not exceed 0.04 inches water gage at 1000 fpm face velocity. Damper assemblies in ductwork subject to above 3-inch water gauge static air pressure shall be constructed to meet SMACNA Seal Class "A" construction requirements.

Provide the damper operating linkages outside of the air stream, including crank arms, connecting rods, and other hardware that transmits motion from the damper actuators to the dampers, shall be adjustable. Additionally, operating linkages shall be designed and constructed to have a 2 to 1 safety factor when loaded with the maximum required damper operating force. Linkages shall be brass, bronze, galvanized steel, or stainless steel.

Provide access doors or panels in hard ceilings and walls for access to all concealed damper operators and damper locking setscrews.

For field-installed control dampers, a single damper section shall have blades no longer than 48 inches and no higher than 72 inches. The maximum damper blade width shall be 12 inches. Larger sized dampers shall be built using a combination of sections.

Frames shall be at least 2 inches wide. Flat blades shall have edges folded for rigidity. Blades shall be provided with compressible gasket seals along the full length of the blades to prevent air leakage when closed.

The damper frames shall be provided with jamb seals to minimize air leakage. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F.

The leakage rate of each damper when full-closed shall be no more than 4 cfm per sq. foot of damper face area at 1.0 inches water gage static pressure.

2.3.2 Control Valves

2.3.2.1 Valve Assembly

Valve bodies shall be designed for 125 psig minimum working pressure or 150 percent of the operating pressure, whichever is greater. Valve stems shall be Type 316 stainless steel. Valve leakage ratings shall be 0.01 percent of rated Cv value. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall meet the requirements of ASME B16.5. Cast iron valve components shall meet the requirements of ASTM A126 Class B or C.

2.3.2.2 Butterfly Valves

Butterfly valves shall be the threaded lug type suitable for dead-end service and for modulation to the fully-closed position, with stainless steel shafts supported by bearings, non-corrosive discs geometrically interlocked with or bolted to the shaft (no pins), and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a means of manual operation independent of the actuator.

2.3.2.3 Two-Way Valves

Two-way modulating valves shall have an equal percentage characteristic.

2.3.2.4 Three-Way Valves

Three-way valves shall have an equal percentage characteristic.

2.3.2.5 Valves for Glycol Fluid Service

- a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.
- b. Internal valve trim shall be brass or bronze, except that valve stems shall be stainless steel.
- c. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

- d. Valves 4 inches and larger shall be butterfly valves, unless indicated otherwise.

2.3.3 Actuators

Provide direct-drive electric actuators for all control applications, except where indicated otherwise.

2.3.3.1 Electric Actuators

Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators shall function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds. Provide two-position actuators of single direction, spring return, or reversing type. Provide modulating actuators capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Thermal type actuators may only be used on terminal fan coil units, terminal VAV units, convectors, and unit heaters. Spring return actuators shall be provided on all control dampers and all control valves except terminal fan coil units, terminal VAV units, convectors, and unit heaters; unless indicated otherwise. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

2.3.4 Output Switches

2.3.4.1 Control Relays

Field installed and DDC panel relays shall be double pole, double throw, UL listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

2.4.1 Transformers

Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer.

2.4.2 Surge and Transient Protection

Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

2.4.2.1 Power Line Surge Protection

Provide surge suppressors on the incoming power at each controller or grouped terminal controllers. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:

- a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.
- b. The device shall react within 5 nanoseconds and automatically reset.
- c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.
- d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.
- e. The primary suppression system components shall be pure silicon avalanche diodes.
- f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.
- g. The device shall have an indication light to indicate the protection components are functioning.
- h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.
- i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.
- j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.
- k. The device shall be capable of operating between minus 20 degrees F and plus 122 degrees F.

2.4.2.2 Telephone and Communication Line Surge Protection

Provide surge and transient protection for DDC controllers and DDC network related devices connected to phone and network communication lines, in accordance with the following:

- a. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges.
- b. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology.
- c. The device shall be installed at the distance recommended by its manufacturer.

2.4.2.3 Controller Input/Output Protection

Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices.

Fuses are not permitted for surge protection.

2.4.3 Wiring

Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, in attics, and within ductwork.

2.4.3.1 Power Wiring

The following requirements are for field-installed wiring:

- a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
- b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.4.3.2 Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

2.5 INDICATORS

2.5.1 Thermometers

Provide bi-metal type thermometers at locations shown. Thermometers shall have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy shall be plus or minus 2 percent of the scale range.

2.5.2 Pressure Gauges for Piping Systems

Provide pipe-mounted pressure gauges at the locations shown. Gauges shall conform to ASME B40.100 and have a 4-inch diameter dial and shutoff cock. Provide gauges in steam piping with a pressure snubber pigtail fitting. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy shall be plus or minus 2 percent of the scale range.

2.5.3 Pressure Gauges for Pneumatic Controls

Provide a pressure gauge at each pneumatic control input and output. Gauges shall have a 2-inch diameter face and a 0 to 30 psi scale with 1 psi graduations.

PART 3 EXECUTION

3.1 INSTALLATION

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 BACnet Naming and Addressing

Coordinate with the BAS Owner and provide unique naming and addressing for BACnet networks and devices.

a. MAC Address

Every BACnet device shall have an assigned and documented MAC Address unique to its network. For Ethernet networks, document the MAC Address assigned at its creation. For ARCNET or MS/TP, assign from 00 to 64.

b. Network Numbering

Assign unique numbers to each new network installed on the BACnet internetwork. Provide ability for changing the network number; either by device switches, network computer, or field operator interface. The BACnet internetwork (all possible connected networks) can contain up to 65,534 possible unique networks.

c. Device Object Identifier Property Number

Assign unique Device "Object_Identifier" property numbers or device instances for each device on the BACnet internetwork. Provide for future modification of the device instance number; either by device switches, network computer, or field interface. BACnet allows up to 4,194,302 possible unique devices per internetwork.

d. Device Object Name Property Text

The Device Object Name property field shall support 32 minimum printable characters. Assign unique Device "Object_Name" property names with plain-English descriptive names for each device. For example, the Device Object Name that for the device controlling the chiller plant at Building 3408 would be:

Device Object_Name = CW System B3408

A Device Object Name for a VAV box controller might be:

Device Object_Name = VAV BOX25

e. Object Name Property Text (Other than Device Objects)

The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include "Zone 1 Temperature" and "Fan Start/Stop".

f. Object Identifier Property Number (Other than Device Objects)

Assign Object Identifier property numbers according to design drawings

or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor's discretion but must be approved by the Government. In this case they must be documented and unique for like object types within the device.

3.1.2 Minimum BACnet Object Requirements

a. Use of Standard BACnet Objects

For the following points and parameters, use standard BACnet objects, where all relevant object properties can be read using BACnet's Read Property Service, and all relevant object properties can be modified using BACnet's Write Property Service:

all device physical inputs and outputs, all set points, all PID tuning parameters, all calculated pressures, flow rates, and consumption values, all alarms, all trends, all schedules, and all equipment and lighting circuit operating status.

b. BACnet Object Description Property

The Object Description property shall support 32 minimum printable characters. For each object, complete the description property field using a brief, narrative, plain English description specific to the object and project application. For example: "HW Pump 1 Proof." Document compliance, length restrictions, and whether the description is writeable in the device PICS.

c. Analog Input, Output, and Value Objects

Support and provide Description and/or Device_Type text strings matching signal type and engineering units shown on the points list.

d. Binary Input, Output, and Value Objects

Support and provide Inactive_Text and Active_Text property descriptions matching conditions shown on the points list.

e. Calendar Object

For devices with scheduling capability, provide at least one Calendar Object with ten-entry capacity. All operators may view Calendar Objects; authorized operators may make modifications from a workstation. Enable the writeable Date List property and support all calendar entry data types.

f. Schedule Object

Use Schedule Objects for all building system scheduling. All operators may view schedule entries; authorized operators may modify schedules from a workstation.

g. Loop Object or Equal

Use Loop Objects or equivalent BACnet objects in each applicable field device for PID control. Regardless of program method or object used, allow authorized operators to adjust the Update Interval, Setpoint, Proportional Constant, Integral Constant, and Derivative Constant using BACnet read/write services.

3.1.3 Minimum BACnet Service Requirements

a. Command Priorities

Use commandable BACnet objects to control machinery and systems, providing the priority levels listed below. If the sequence of operation requires a different priority, obtain approval from the Contracting Officer.

<u>Priority Level</u>	<u>Application</u>
1	Manual-Life Safety
2	Automatic-Life Safety
3	(User Defined)
4	(User Defined)
5	Critical Equipment Control
6	Minimum On/Off
7	(User Defined)
8	Manual Operator
9	(User Defined)
10	(User Defined)
11	Load Shedding
12	(User Defined)
13	(User Defined)
14	(User Defined)
15	(User Defined)
16	(User Defined)

b. Alarming

- (1) Alarm Priorities - Coordinate alarm and event notification with the BAS Owner.
- (2) Notification Class - Enable writeable Priority, Ack Required, and Recipient List properties of Notification Class objects.
- (3) Event Notification Message Texts - Use condition specific narrative text and numerical references for alarm and event notification.

c. Updating Displayed Property Values

Allow workstations to display property values at discrete polled intervals, or based on receipt of confirmed and unconfirmed Change of Value notifications. The COV increment shall be adjustable by an operator using BACnet services, and polled intervals shall be adjustable at the operator workstation.

3.1.4 Local Area Networks

Obtain Government approval before connecting new networks with existing networks. Network numbers and device instance numbers shall remain unique when joining networks. Do not change existing network addressing without Government approval. See also "BACnet Naming and Addressing".

3.1.5 BACnet Routers, Bridges, and Switches

Provide the quantity of BACnet routers, bridges, and switches necessary for communications shown on the BACnet Communication Architecture schematic. Provide BACnet routers with BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network. Configure each BACnet device and bridge, router, or switch to communicate on its network segment.

3.1.6 Wiring Criteria

- a. Run circuits operating at more than 100 volts in rigid or flexible conduit, metallic tubing, covered metal raceways, or armored cable.
- b. Do not run binary control circuit wiring in the same conduit as power wiring over 100 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 100 volts.
- c. Provide circuit and wiring protection required by NFPA 70.
- d. Run all wiring located inside mechanical rooms in conduit.
- e. Do not bury aluminum-sheathed cable or aluminum conduit in concrete.
- f. Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Number each pneumatic tube every six feet. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring methods shall be in accordance with UL 508A.
- g. For controller power, provide new 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable.
- h. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.

- i. Grounding: Ground controllers and cabinets to a good earth ground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit grounding is not acceptable; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at the controller end.
- j. The Contractor shall be responsible for correcting all associated ground loop problems.
- k. Run wiring in panel enclosures in covered wire track.

3.1.7 Accessibility

Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install digital controllers, data ports, and concealed actuators, valves, dampers, and like equipment in locations freely accessible through access doors.

3.1.8 Digital Controllers

- a. Install as stand alone control devices (see definitions).
- b. Locate control cabinets at the locations shown on the drawings. If not shown on the drawings, install in the most accessible space, close to the controlled equipment.

3.1.9 Hand-Off-Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.10 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.10.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor 54 inches above the floor to meet ADA requirements.

3.1.10.2 Duct Temperature Sensors

- a. Probe Type: Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. Seal the duct insulation penetration vapor tight.
- b. Averaging Type (and coil freeze protection thermostats): Weave the capillary tube sensing element in a serpentine fashion perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports. Prevent contact between the capillary and the duct or air handler internals. Provide a duct access door at the sensor location. The access door shall be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will

permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors shall be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.10.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.

3.1.10.4 Outside Air Temperature Sensors

Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.11 Energy Meters

Locate energy meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous and accumulated energy usage.

3.1.12 Damper Actuators

Where possible, mount actuators outside the air stream in accessible areas.

3.1.13 Thermometers and Gages

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.14 Pressure Sensors

Locate pressure sensors as indicated.

3.1.15 Component Identification Labeling

Using an electronic hand-held label maker with white tape and bold black block lettering, provide an identification label on the exterior of each new control panel, control device, actuator, and sensor. Also provide labels on the exterior of each new control actuator indicating the (full) open and (full) closed positions. For labels located outdoors, use exterior grade label tape, and provide labels on both the inside and outside of the panel door or device cover. Acceptable alternatives are white plastic labels with engraved bold black block lettering permanently attached to the control panel, control device, actuator, and sensor. Have the labels and wording approved by the BAS Owner prior to installation.

3.1.16 Network and Telephone Communication Lines

When telephone lines or network connections by the Government are required, provide the Contracting Officer at least 60 days advance notice of need.

3.1.17 Chlorine Sensors

Install chlorine sensors in locations that are accessible and provide a good representation of the sensed media. Avoid locations where sensor can be in direct contact with water. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.18 Propane Sensors

Install propane sensors at Heating and Ventilation Units and at existing locations. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.19 Control System Monitor

Install control monitor on wall with ample anchoring for weight of monitor. Locate monitor next to or adjacent to Instructor Operating Stations (IOS) with guidance from Trainer Operators. Location should be such that full screen can be viewed while either IOS is in operation. Monitor shall be mounted per manufacturer's instructions.

3.2 TEST AND BALANCE SUPPORT

The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel specified under Section 23 05 93 TESTING, ADJUSTING AND BALANCING. This support shall include:

- a. On-site operation and manipulation of control systems during the testing and balancing.
- b. Control setpoint adjustments for balancing all relevant mechanical systems, including VAV boxes.
- c. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.3 CONTROLS SYSTEM OPERATORS MANUALS

Provide three electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Government, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:

- a. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.
- b. A copy of the project's mechanical design drawings, including any official modifications and revisions.
- c. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."
- d. A copy of the project's approved Performance Verification Testing Plan and Report.
- e. A copy of the project's approved final TAB Report.
- f. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.
- g. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.
- h. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.
- i. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.
- j. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.
- k. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support at no additional cost to the Government for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.
- l. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Government for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

3.4 PERFORMANCE VERIFICATION TESTING (PVT)

3.4.1 General

The PVT shall demonstrate compliance of the control system work with the

contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Government. If the project is phased, provide separate testing for each phase. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator, the Contracting Officer's representative. PVT to be coordinated with commissioning functional performance testing. Contractor PVTs to be completed prior to commissioning functional performance testing. Refer to Section 01 91 00.00 40 for additional testing and commissioning requirements

3.4.2 Performance Verification Testing Plan

Submit a detailed PVT Plan of the proposed testing for Government approval. Develop the PVT Plan specifically for the control system in this contract. The PVT Plan shall be a clear list of test items arranged in a logical sequence. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested.

The plan shall clearly describe how each item is tested, indicate where assisting personnel are required (like the mechanical contractor), and include what procedures are used to simulate conditions. Include a separate column for each checked item and extra space for comments. Where sequences of operations are checked, insert each corresponding routine from the project's sequence of operation. For each test area, include signature and date lines for the Contractor's PVT administrator, the Contractor's QA representative, the Contracting Officer's representative, and the BAS Owner to acknowledge successful completion.

3.4.3 PVT Sample Size

Test all central plant equipment and primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control like VAV boxes and fan coil units. The Government may require testing of like controllers beyond a statistical sample if sample controllers require retesting or do not have consistent results.

The Government may witness all testing, or random samples of PVT items. When only random samples are witnessed, the Government may choose which ones.

3.4.4 Pre-Performance Verification Testing Checklist

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

- a. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).
- b. Verify HVAC motors operate below full-load amperage ratings.
- c. Verify all required control system components, wiring, and accessories are installed.
- d. Verify the installed control system architecture matches approved drawings.

- e. Verify all control circuits operate at the proper voltage and are free from grounds or faults.
 - f. Verify all required surge protection is installed.
 - g. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.
 - h. Verify all DDC network communications function properly, including uploading and downloading programming changes.
 - i. Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.
 - j. Verify each digital controller's programming is backed up.
 - k. Verify all wiring, components, and panels are properly labeled.
 - l. Verify all required points are programmed into devices.
 - m. Verify all TAB work affecting controls is complete.
 - n. Verify all valve and actuator zero and span adjustments are set properly.
 - o. Verify all sensor readings are accurate and calibrated.
 - p. Verify each control valve and actuator goes to normal position upon loss of power.
 - q. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.
 - r. Verify each controller works properly in stand-alone mode.
 - s. Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.
 - t. Verify all electrical interlocks work properly.
 - u. Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook.
 - v. Verify the as-built (shop) control drawings are completed.
- 3.4.5 Conducting Performance Verification Testing
- a. Conduct Government-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the Contracting Officer of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT. Ensure that testing personnel are regularly employed in the testing and calibration of DDC systems. Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

- b. During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.
- c. If re-testing is required, follow the procedures for the initial PVT. The Government may require re-testing of any control system components affected by the original failed test.

3.4.6 Controller Capability and Labeling

Test the following for each controller:

- a. Memory: Demonstrate that programmed data, parameters, and trend/ alarm history collected during normal operation is not lost during power failure.
- b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a portable electronic device like a notebook computer or PDA. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.
- c. Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.
- d. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the BACnet Communication Architecture Schematic and floor plans.
- e. Nameplates and Tags: Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

3.4.7 Workstation and Software Operation

For every user workstation or notebook provided:

- a. Show points lists agree with naming conventions.
- b. Show that graphics are complete.
- c. Show the UPS operates as specified.

3.4.8 BACnet Communications and Interoperability Areas

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a BACnet protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

- a. Data Presentation: On each BACnet Operator Workstation, demonstrate graphic display capabilities.

- b. Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.
- c. Setpoint and Parameter Modifications: Show the ability to modify all setpoints and tuning parameters in the sequence of control or listed on project schedules. Modifications are made with BACnet messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
- d. Peer-to-Peer Data Exchange: Show all BACnet devices are installed and configured to perform BACnet read/write services directly (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.
- e. Alarm and Event Management: Show that alarms/events are installed and prioritized according to the BAS Owner. Demonstrate time delays and other logic is set up to avoid nuisance tripping, e.g., no status alarms during unoccupied times or high supply air during cold morning start-up. Show that operators with sufficient privilege can read and write alarm/event parameters for all standard BACnet event types. Show that operators with sufficient privilege can change routing (BACnet notification classes) for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved (TO-OFF NORMAL, TO-NORMAL, etc.).
- f. Schedule Lists: Show that schedules are configured for start/stop, mode change, occupant overrides, and night setback as defined in the sequence of operations.
- g. Schedule Display and Modification: Show the ability to display any schedule with start and stop times for the calendar year. Show that all calendar entries and schedules are modifiable from any connected workstation by an operator with sufficient privilege.
- h. Archival Storage of Data: Show that data archiving is handled by the operator workstation/server, and local trend archiving and display is accomplished with BACnet Trend Log objects.
- i. Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.
- j. Device and Network Management: Show the following capabilities:
 - (1) Display of Device Status Information
 - (2) Display of BACnet Object Information
 - (3) Silencing Devices that are Transmitting Erroneous Data
 - (4) Time Synchronization
 - (5) Remote Device Reinitialization
 - (6) Backup and Restore Device Programming and Master Database(s)
 - (7) Configuration Management of Half-Routers, Routers and BBMDs

3.4.9 Execution of Sequence of Operation

Demonstrate that the HVAC system operates properly through the complete sequence of operation. Use read/write property services to globally read and modify parameters over the internetwork.

3.4.10 Control Loop Stability and Accuracy

For all control loops tested, give the Government trend graphs of the control variable over time, demonstrating that the control loop responds to a 20 percent sudden change of the control variable set point without excessive overshoot and undershoot. If the process does not allow a 20 percent set point change, use the largest change possible. Show that once the new set point is reached, it is stable and maintained. Control loop trend data shall be in real-time with the time between data points 30 seconds or less.

3.4.11 Performance Verification Testing Report

Upon successful completion of the PVT, submit a PVT Report to the Government and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.

3.5 TRAINING REQUIREMENTS

Provide a qualified instructor (or instructors) with two years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Contracting Officer and BAS Owner after receiving approval of the training course documentation. Training shall take place at the job site and/or a nearby Government-furnished location. A training day shall occur during normal working hours, last no longer than 8 hours and include a one-hour break for lunch and two additional 15-minute breaks. The project's approved Controls System Operators Manual shall be used as the training text. The Contractor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of training. Refer to Section 01 91 00.00 40 COMMISSIONING for additional training requirements.

3.5.1 Training Documentation

Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopsis of each lesson, and the instructor's background and qualifications. The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

3.5.2 Phase I Training - Fundamentals

The Phase I training session shall last one day and be conducted in a classroom environment with complete audio-visual aids provided by the contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all visual aids used. Upon completion of the Phase I Training, each trainee should fully understand the project's DDC system fundamentals. The

training session shall include the following:

- a. BACnet fundamentals (objects, services, addressing) and how/where they are used on this project
- b. This project's list of control system components
- c. This project's list of points and objects
- d. This project's device and network communication architecture
- e. This project's sequences of control, and:
- f. Alarm capabilities
- g. Trending capabilities
- h. Troubleshooting communication errors
- i. Troubleshooting hardware errors

3.5.3 Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The Phase II training session shall last one day and be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Phase II Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:

- a. A walk-through tour of the mechanical system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)
- b. A discussion of the components and functions at each DDC panel
- c. Logging-in and navigating at each operator interface type
- d. Using each operator interface to find, read, and write to specific controllers and objects
- e. Modifying and downloading control program changes
- f. Modifying setpoints
- g. Creating, editing, and viewing trends
- h. Creating, editing, and viewing alarms
- i. Creating, editing, and viewing operating schedules and schedule objects
- j. Backing-up and restoring programming and data bases
- k. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics

- l. Creating new graphics and adding new dynamic data displays and links
- m. Alarm and Event management
- n. Adding and removing network devices

-- End of Section --

SECTION 23 11 25

FACILITY GAS PIPING
11/08

PART 1 GENERAL

1.1 SUMMARY

This specification section applies to incidental underground piping, above ground steel piping both outside and within buildings in compliance with NFPA 54/AGA Z223.1NFPA 58, "Fuel Gas Piping" and NFPA 58, Liquefied Petroleum Gas Code.

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 GAS ASSOCIATION (AGA)

AGA XR0603 (2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AGA Z223.1 (2012) National Fuel Gas Code

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110 (2013) Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide

API RP 2003 (2008; 7th Ed) Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

API RP 2009 (2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants

API Spec 6D (2014) Specification for Pipeline Valves

API Std 598 (2009) Valve Inspecting and Testing

API Std 607 (2010) Testing of Valves: Fire Test for Soft-Seated Quarter-Turn Valves

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

AWS WHB-2.9 (2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007; R 2013) Scheme for the Identification of Piping Systems
ASME B1.1	(2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013) Pipe Threads, General Purpose (Inch)
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 B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
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 B31.9	(2014) Building Services Piping
ASME B36.10M	(2004; R 2010) Standard for Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM 01.01	(2014) Steel - Piping, Tubing, Fittings
ASTM A105/A105M	(2013) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A181/A181M	(2013) Standard Specification for Carbon

Steel Forgings, for General-Purpose Piping

ASTM A193/A193M (2014) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A194/A194M (2014) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

ASTM A513/A513M (2014) Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

ASTM A53/A53M (2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

CSA GROUP (CSA)

CGA 3.11-M88 (1988; R 2014) Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves

CGA 9.2-M88 (1988; R 2009) Manually Operated Shut-Off Valves for Gas Piping Systems

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

MSS SP-25 (2013) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

MSS SP-69 (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2015) National Fuel Gas Code

NFPA 58 (2014; TIA 13-1; TIA 13-2; Errata 13-1; TIA 13-3; Errata 14-2) Liquefied Petroleum Gas Code

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines &
for Compressed Gas Cylinders

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE (2012) Flammable and Combustible Liquids
and Gases Equipment Directory

1.3 SYSTEM DESCRIPTION

The gas piping system includes liquid petroleum piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein. Provide cathodically protected insulating joints connecting aboveground piping from the meter to the building, with zinc grounding cells conforming to API RP 2003, installed where indicated.

1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers and cathodic protection system; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.

1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G

SD-03 Product Data

Pipe and Fittings; G
Gas equipment connectors; G

Gas Piping System; G
Pipe Coating Materials; G

Transition fittings; G
Valves; G
Warning and identification tape; G

SD-06 Test Reports

Testing; G
Pressure Tests; G
Pressure Tests for Liquefied Petroleum Gas; G
Test With Gas; G

SD-07 Certificates

Welders procedures and qualifications; G
assigned number, letter, or symbol; G

SD-08 Manufacturer's Instructions

pipe coating materials; G

SD-10 Operation and Maintenance Data

Gas facility system and equipment operation; G
Gas facility system maintenance; G
Gas facility equipment maintenance; G

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

1.5.1 Welding Qualifications

- a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.
- b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer.
Weld all structural members in accordance with Section 05 12 00 STRUCTURAL STEEL, and in conformance with AWS A5.8/A5.8M, and AWS WHB-2.9.

1.5.2 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports. Include LP storage tank, pad, and mounting details.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Plastic Pipe

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54, NFPA 58 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

- a. Pipe: Black carbon steel in accordance with ASTM A53/A53M, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.
- b. Threaded Fittings: ASME B16.3, black malleable iron.
- c. Socket-Welding Fittings: ASME B16.11, forged steel.
- d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.
- e. Unions: ASME B16.39, black malleable iron.
- f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1, with flange faces having integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel

buttwelding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and ASTM A181/A181M, Class 60.

2.2.2 Steel Tubing, Joints and Fittings

Provide steel tubing conforming to ASTM 01.01, and ASTM A513/A513M, with tubing joints made up with gas tubing fittings recommended by the tubing manufacturer.

2.2.3 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL FLAMMABLE & COMBUSTIBLE.

2.2.4 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.5 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

2.2.6 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.7 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.8 Gas Transition Fittings

- a. Provide lever operated pressure lubricated plug type gas shut-off valve conforming to CGA 3.11-M88. Provide manually operated shut-off valve conforming to CGA 9.2-M88

2.2.9 Insulating Pipe Joints

2.2.9.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.9.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.9.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.3 VALVES

Provide lockable shutoff or service isolation valves as indicated in the drawings conforming to the following:

2.3.1 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

2.4 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58 and MSS SP-69.

2.5 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.6 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.7 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

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 or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the meter set assembly as specified in Section 33 51 15 NATURAL-GAS / LIQUID PETROLEUM GAS DISTRIBUTION, to the connections to each gas utilization device.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.3.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 PROTECTIVE COVERING

3.4.1 Underground Metallic Pipe

Protect buried metallic piping and tubing from corrosion by either: (1) applying protective coatings as specified in Section 33 51 15 NATURAL-GAS / LIQUID PETROLEUM GAS DISTRIBUTION.

3.4.2 Aboveground Metallic Piping Systems

3.4.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing or commercial sand blasted conforming to SSPC SP 6/NACE No.3 and prime with ferrous metal primer or vinyl type wash coat. Finish primed surfaces with two coats of exterior oil paint or vinyl paint.

3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, NFPA 58 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

3.5.1 Metallic Piping Installation

Bury underground piping a minimum of 18 inches below grade. Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Do not use aluminum alloy pipe in exterior locations or underground.

3.5.2 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

3.5.3 Final Gas Connections

Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.6.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.7 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic.

3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section

22 00 00 PLUMBING, GENERAL PURPOSE.

3.9 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54NFPA 58.

3.11 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.12 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54NFPA 58. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building which is electrically continuous and bonded to a grounding electrode as required by NFPA 70.

3.14 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.15 CATHODIC PROTECTION

Provide cathodic protection for underground ferrous gas piping as specified in Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.16 TESTING

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, purge the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the Contracting Officer. Do not use oxygen as a testing medium.

3.16.1 Pressure Tests

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 and as specified in NFPA 58 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.16.2 Pressure Tests for Liquified Petroleum Gas

Pressure test system as described above. When appliances are connected to the piping system, use fuel gas for testing appliances to withstand a pressure of not less than 10.0 inches nor more than 14.0 inches water column (0.36 nor more than 0.51 pounds per square inch) for a period of not less than 10 minutes without showing any drop in pressure. Measure pressure with a water manometer or an equivalent device calibrated to be read in increments of not greater than 0.1 inch water column. Isolate the source of pressure before the pressure tests are made.

3.16.3 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54NFPA 58. If leakage is recorded, shut off the gas supply, repair the leak , and repeat the tests until all leaks have been stopped.

3.16.4 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. LPG piping tested using fuel gas with appliances connected does not require purging. Conform testing procedures to API RP 1110. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined

spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 and NFPA 58 are followed.

3.16.5 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.17 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

SECTION 23 31 13.00 40

METAL DUCTS

11/12

PART 1 GENERAL

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS apply to work specified in this section.

Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT applies to work 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.

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 (2013) 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 (2013) 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 (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A924/A924M (2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2015) 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

UNDERWRITERS LABORATORIES (UL)

UL 181 (2013) 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-02 Shop Drawings

Record Drawings; G

SD-03 Product Data

Turning Vanes; G

Flexible Connectors; G

Flexible Duct Materials; G

Power Operated Dampers; G

Gravity Backdraft and Relief Dampers; G

Material, equipment, and fixture lists

Galvanized Steel Ductwork Materials

Brazing Materials

Mill-Rolled Reinforcing and Supporting Materials

Round Sheet Metal Duct Fittings

Manual Volume Dampers

Listing of product installations

SD-06 Test Reports

Ductwork Leakage Tests; G

Operational Tests

SD-07 Certificates

Turning Vanes; G

Dampers; G

Flexible Connectors; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Power Operated Dampers; 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.

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. Do not use rigid fibrous-glass ductwork.

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

<u>DUCT WIDTH</u> <u>INCHES</u>	<u>GAGE</u>
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/A36M for 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.

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

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.

Ensure cutouts in fitting body are equal to branch tap dimension or, where smaller, excess material is flared and rolled into smooth radius nozzle configuration.

2.3.2 Reinforcement

Support inner liners of both duct and fittings by metal spacers welded in position to maintain spacing and concentricity.

2.3.3 Fittings

Make divided flow fittings as separate fittings, not tap collars into duct sections, with the following construction requirements:

- a. Sound, airtight, continuous welds at intersection of fitting body and tap

- b. Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches
- c. Carefully fit branch connection to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Continuously braze seams in the pressure shell of fittings. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

Construct two-piece type elbows for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

2.3.4 Turning Vanes

Provide double-wall type turning vanes, commercially manufactured for high-velocity system service.

2.3.5 Dampers

Construct low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

2.3.6 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.

2.3.7 Duct Hangers

For duct hangers in contact with galvanized duct surfaces, provide galvanized steel painted with inorganic zinc.

2.3.8 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.

2.3.9 Flexible Duct Materials

Ensure flexible duct connectors comply with NFPA 90A, and conform with UL 181, Class 1 material.

Provide wire-reinforced fibrous-glass duct consisting of a minimum 1 pound/cubic foot density fibrous glass, bonded to and supported by corrosion-protected spring helix. Vapor barriers are a minimum of 4 mil, pigmented polyvinylchloride film. Ensure duct is bendable without damage through 180 degrees with an inside bend radius not greater than two duct diameters. Minimum wall thickness is 1 inch. Thermal conductivity is not greater than 0.23 Btu per hour per square foot per degrees F at 75 degrees F mean temperature. Ensure permeance is not greater than 0.10 perm.

Working pressure range is from minus 1/2 inchwg to plus 1-1/2 inches wg. Working temperature ranges from minus 20 to plus 250 degrees F. Minimum sustained velocity without delamination is 2,400 fpm. Use materials conforming to NFPA 90A.

2.3.10 Manual Volume Dampers

Conform to SMACNA 1966 for volume damper construction.

Equip dampers with an indicating quadrant regulator with a locking feature externally located and easily accessible for adjustment and standoff brackets to allow mounting outside external insulation. Where damper rod lengths exceed 30 inches, provide a regulator at each end of damper shaft.

2.3.10.1 Damper Construction

Provide all damper shafts with two-end bearings.

Ensure splitter damper is 22-gage sheet metal and is 2 gages heavier than duct in which installed.

Provide a full length damper shaft and extend it beyond the damper blade. use a 3/8 inch square shaft for damper lengths up to 20 inches and a 1/2 inch square shaft for damper lengths 20 inches and larger. Where necessary to prevent damper vibration or slippage, provide adjustable support rods with locking provisions external to duct at damper blade end.

Provide dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches of multiblade type having a substantial frame with blades fabricated of 16-gage metal. Provide blades not exceeding 10 inches in width and 48 inches in length, pinned or welded to 1/2 inch diameter shafts. Ensure dampers greater than 48 inches in width are made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. Provide blades with graphite-impregnated nylon bearings and connect so that adjoining blades rotate in opposite directions.

2.3.11 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 graphite-impregnated nylon or 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.

2.3.11.1 Blade Construction

Maximum blade width is 9 inches, and maximum blade length is 36 inches. Blade material is 18-gage AISI 18-8 corrosion-resistant 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.

2.3.12 Power-Operated Dampers

Ensure dampers conform to applicable requirements specified under Section 23 09 23.13 20 DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

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.

3.2.2 Ducts

Wherever ducts pass through firewalls or through walls or floors dividing conditioned spaces from unconditioned spaces, provide a flanged segment in that surface during surface construction.

Where interiors of ducting may be viewed through air diffusion devices, construct the viewed interior with sheet metal and paint flat black.

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 or dovetailed at joints.

3.3.1.3 Flexible Duct Joints

Between flexible duct without sheet metal collars and round metal ductwork connections make joints by trimming the ends, coating the inside of the flexible duct for a distance equal to depth of insertion with elastomer caulk, and by securing with sheet metal screws or binding with a strap clamp.

3.3.1.4 Square Elbows

Provide single-vane duct turns in accordance with SMACNA 1966.

3.3.1.5 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 <u>INCHES</u>	RADIUS OF TURNING		
	VANES IN PERCENT OF DUCT WIDTH		
	<u>VANE NO. 1</u>	<u>VANE NO. 2</u>	<u>VANE NO. 3</u>
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.

3.3.1.6 Outlets, Inlets, And Duct Branches

Install branches, inlets, and outlets so that air turbulence is reduced to a minimum and air volume properly apportioned. Install adjustable splitter dampers at all supply junctions to permit adjustment of the amount of air entering the branch. Wherever an air-diffusion device is shown as being installed on the side, top, or bottom of a duct, and whenever a branch takeoff is not of the splitter type; provide a commercially manufactured 45 degree side-take-off (STO) fitting with manual volume damper to allow adjustment of the air quantity and to provide an even flow of air across the device or duct it services.

Where a duct branch is to handle more than 25 percent of the air handled by the duct main, use a complete 90-degree increasing elbow with an inside radius of 0.75 times branch duct width. Size of the leading end of the increasing elbow within the main duct with the same ratio to the main duct size as the ratio of the related air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, construct the branch connection with a 45 degree side take-off entry in accordance with SMACNA 1966.

3.3.1.7 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.

3.3.1.8 Branch Connections

Construct radius tap-ins in accordance with SMACNA 1966.

3.3.1.9 Access Openings

Construct access door in accordance with SMACNA 1966, except that sliding doors may be used only for special conditions upon prior approval. Provide double-panel type doors.

Install access doors and panels in ductwork upstream from coils, adjacent to fire dampers and at controls or at any item requiring periodic inspection, adjustment, maintenance, or cleaning.

Minimum access opening size is 12 by 18 inches, unless precluded by duct dimensions or otherwise indicated.

Make airtight access doors that leak by adding or replacing hinges and latches or by construction of new doors adequately reinforced, hinged, and latched.

3.3.1.10 Manual Volume Dampers

Provide balancing dampers of the splitter, butterfly, or multilouver type, to balance each respective main and branch duct.

For dampers regulated through ceilings provide a regulator concealed in a box mounted in the ceiling, with a cover finish aesthetically compatible with ceiling surface. Where ceiling is of removable construction, set regulators above the ceiling, and mark the location on ceiling in a manner acceptable to the Contracting Officer.

3.3.1.11 Flexible Connectors For Sheet Metal

Connect air handling equipment, ducts crossing building expansion joints, and fan inlets and outlets to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative, and vibration isolation mountings have been adjusted. When system fans are operating, ensure connectors are free of wrinkle caused by misalignment or fan reaction. Width of surface is curvilinear.

3.3.2 Rectangular Sheet Metal Ducts

3.3.2.1 Medium-Pressure Gages, Joints, And Reinforcement

Ensure minimum sheet metal gages, joints, and reinforcements between joints are in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Ensure sheet metal minimum thickness, transverse reinforcement between joints, and joints of ducts are in accordance with the following:

LONGEST SIDE INCHES	SHEET METAL GAGE ALL SIDES	COMPANION ANGLE INCHES	REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK)
97 to 108	16	2 by 2 by 1/8, two tie rods along angle	Two 2 by 2 by 1/8, two tie rods along angle
109 to 132	16	2 by 2 by 3/16, two tie rods along angle	Two 2 by 2 by 3/16, two tie rods along angle
133 and longer	14	2 by 2 by 3/16, with tie rods every 48 inches	Two 2 by 2 by 3/16, with tie rods every 48 inches

3.3.2.2 Medium- And High-Pressure Branches, Inlets, Outlets

Install branches, inlets, and outlets to minimize air turbulence and to ensure proper airflow.

Install dampers so that the amount of air entering duct mains is adjustable.

Provide commercially manufactured air extractors to allow adjustment of the air quantity and to provide an even flow of air across the device or duct served.

3.3.2.3 Duct Branch Transition

Where a duct branch handles over 25 percent of the air transported by the duct main, use a complete 90-degree increasing, with an inside radius of 0.75 times duct branch width. Ensure the size of the trailing end of the increasing elbow within the main duct is in the same ratio to the main duct size as the ratio of the relative air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, provide a branch connection with an inside radius of 0.75 times branch duct width, a minimum arc length of 45 degrees, and an outside radius of 1.75 times duct branch width. Place arc tangent to duct main.

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 tack welded to duct. Locate girth angles as follows:

<u>DIAMETER, INCHES</u>	<u>REINFORCEMENT-MAXIMUM SPACING, INCHES</u>
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.

Continuously weld flanges to duct on outside of duct and intermittently welded with 1 inch welds every 4 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 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.

3.3.4 Transverse Reinforcement Joints

Provide transverse reinforcements that are spot welded 4 inches on center. Weld transverse reinforcement at all corners 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 or dovetailed at joints.

3.3.6 Radius Elbows

Fabricate elbow proportions and radius elbows in accordance with ASHRAE EQUIP IP HDBK, Chapter 16 and 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 and ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

3.3.8 Access Openings

Install access panels in ductwork adjacent to fire dampers.

Minimum size of access opening is 12 by 18 inches, unless precluded by duct dimension.

Frame access openings with welded and ground miter joints, 1/8 inch thick angle iron, with 1/4 inch studs welded to frame. Ensure cover plates are not less than 16-gage, reinforced as necessary for larger sizes.

In lieu of access doors, use readily accessible flanged duct sections upon approval. Provide stable hanger supports for disconnected duct terminal.

3.3.9 Duct Supports

Install duct support in accordance with ASHRAE EQUIP IP HDBK, Chapter 16 and ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Meet the minimum size for duct hangers as specified in ASHRAE EQUIP IP HDBK, Chapter 16 and ASHRAE FUN IP,

Chapter 32 and SMACNA 1966. Provide two hangers where necessary to eliminate sway. Support attachment to duct surfaces by bolt 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.

3.3.9.1 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.

3.3.9.2 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.

3.3.9.3 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.

3.3.9.4 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:

<u>WIDTH OF DUCT, INCHES</u>	<u>MINIMUM BOTTOM ANGLE SIZE, INCHES</u>
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

3.3.9.5 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.

3.3.9.6 Vibration Isolation

Isolate from vibration duct supports from structure at points indicated.

Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

3.3.10 Flexible Connectors For Steel Metal

Connect air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, ensure connectors are free of wrinkles caused by misalignment or fan reaction. Width of surface is curvilinear.

3.3.11 Insulation Protection Angles

Provide galvanized 20-gage sheet, formed into an angle with a 2 inch exposed long leg with a 3/8 inch stiffening 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.

3.3.12 Duct Probe Access

Provide holes with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Provide extended-neck fittings where probe access area is insulated.

3.3.13 Openings In Roofs And Walls

Building openings are fixed and provide equipment to suit.

3.4 FIELD QUALITY CONTROL

3.4.1 Fire Damper Tests

Perform operational tests on each fire damper in the presence of the Contracting Officer by energizing a fusible link with localized heat. Provide new links and install after successful testing.

3.4.2 Ductwork Leakage Tests

Conduct complete leakage test of new ductwork in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Perform tests prior to installing ductwork insulation.

3.4.3 Inspection

Inspect ductwork in accordance with SMACNA 1987.

3.5 DUCTWORK CLEANING PROVISIONS

Protect open ducting from construction dust and debris in a manner approved by the Contracting Officer. Clean dirty assembled ducting by subjecting all main and branch interior surfaces to airstreams moving at velocities

two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property; wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; or other means approved by the Contracting Officer. Use water- and oil- free compressed air for cleaning ducting. After construction is complete, and prior to acceptance of the work, remove construction dust and debris from exterior surfaces.

3.6 OPERATION AND MAINTENANCE

Submit 4 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 82 02.00 10

UNITARY HEATING AND COOLING EQUIPMENT
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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

- AHRI 320 (1998) Water-Source Heat Pumps
- AHRI 410 (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
- AHRI 700 (2012; Add 1 2013) Specifications for Fluorocarbon Refrigerants
- ANSI/AHRI 495 (2005) Performance Rating of Refrigerant Liquid Receivers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- ANSI/ASHRAE 15 & 34 (2013; Addenda A 2014; ERTA 2014) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
- ASHRAE 52.2 (2012; Errata 2013) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN WELDING SOCIETY (AWS)

- AWS Z49.1 (2012) Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

- ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications
- ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

- ASTM A307 (2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

Strength

ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C1071	(2012) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F104	(2011) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 1995	(2011) Heating and Cooling Equipment
UL 207	(2009; Reprint Jun 2014) Refrigerant-Containing Components and Accessories, Nonelectrical
UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units
UL 900	(2004; Reprint Feb 2012) Standard for Air Filter Units

1.2 SYSTEM DESCRIPTION

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be the premium efficiency type in accordance with NEMA MG 1. Field wiring shall be in accordance with manufacturer's

instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

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

Drawings

SD-03 Product Data

Materials and Equipment
Spare Parts
Posted Instructions
Verification of Dimensions

SD-07 Certificates

Materials and Equipment
Service Organization

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Submit drawings provided in adequate detail to demonstrate compliance with contract requirements. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

- a. Equipment layouts which identify assembly and installation details.
- b. Plans and elevations which identify clearances required for maintenance

and operation.

- c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.
- e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- f. Automatic temperature control diagrams and control sequences.
- g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. 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 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide Materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. Submit 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, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements.

- a. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Data shall be submitted for each specified component.
- b. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall

include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

- c. Where the system, components, or equipment are specified to comply with requirements of AHRI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted.
- d. When performance requirements of this project's drawings and specifications vary from standard AHRI rating conditions, computer printouts, catalog, or other application data certified by AHRI or a nationally recognized laboratory as described above shall be included. If AHRI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.
- e. Products shall be supported by a service organization. Submit a certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. System components shall be environmentally suitable for the indicated locations.

2.1.2 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.1.3 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

2.2 UNITARY EQUIPMENT, SPLIT SYSTEM

Unit shall be an water-cooled, split system which employs a remote drycooler, a separate indoor unit, and interconnecting refrigerant piping. Unit shall

be the dehumidification type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with AHRI 320. Unit shall be provided with necessary fans, air filters, coil frost protection, liquid receiver, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "Unitary Equipment Components". The remote unit shall be as specified in paragraph ACCESSORIES. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type.

2.2.1 Air-to-Refrigerant Coil

Coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.2.2 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Compressors of 10 tons and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, lubrication pump, high and low pressure safety cutoffs and protection against short cycling.

2.2.3 Refrigeration Circuit

Refrigerant-containing components shall comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve. A refrigerant suction line thermostatic and water flow switch control shall be provided to prevent freeze-up in event of loss of water flow during heating cycle.

2.2.4 Unit Controls

Unit shall be internally prewired with a 24 or 120 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high

and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls shall sustain unit operation with ambient temperature of 32 degrees F. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995. Low cost cooling shall be made possible by means of a control circuit which will modulate dampers to provide 100 percent outside air while locking out compressors.

2.3 EQUIPMENT EFFICIENCY

Unit shall have an efficiency as indicated.

2.4 UNITARY EQUIPMENT COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. Refrigerants shall meet the requirements of AHRI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.4.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a open dripproof totally enclosed enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Direct-drive fan motors shall be of the multiple-speed variety. Belt-driven fans shall have adjustable sheaves to provide not less than 125 percent fan-speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans shall be direct-drive drive type with fixed pitch blades. Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields.

2.4.3 Primary/Supplemental Heating

2.4.3.1 Water Coil

Coil shall conform to the provisions of AHRI 410. Coil shall be fin-and-tube type constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to tubes. Headers shall be constructed of cast iron, welded steel or copper. Coil shall be constructed to float within the casing to allow free expansion and contraction of tubing. Casing and tube support sheets shall not be lighter than 16 gauge galvanized steel formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Coil shall be circuited for suitable water velocity without excessive pressure drop and properly pitched for drainage where required or indicated. Each coil shall be tested at the factory under water at not less than 300 psi air pressure, tested hydrostatically after assembly of the unit and proved tight under a gauge pressure of 200 psi. Coil shall be suitable for use with water up to 250 degrees F. Coil shall allow complete coil drainage with a pitch of not less than 1/8 inch/foot slope to drain.

2.4.4 Air Filters

Air filters shall be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method shall be as listed under the label service and shall meet the requirements of UL 586.

2.4.4.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth sectional type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested in accordance with ASHRAE 52.2. Initial resistance at 500 feet/minute will not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. Four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.4.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

2.4.6 Pressure Vessels

Pressure vessels shall conform to ASME BPVC SEC VIII D1 or UL 207, as applicable for maximum and minimum pressure or temperature encountered. Where referenced publications do not apply, pressure components shall be tested at 1-1/2 times design working pressure. Refrigerant wetted carbon steel surfaces shall be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

2.4.6.1 Hot Gas Muffler

Unit shall be selected by the manufacturer for maximum noise attenuation. Units rated for 30 tons capacity and under may be field tunable type.

2.4.6.2 Liquid Receiver

A liquid receiver shall be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver shall be designed, filled, and rated in accordance with the recommendations of ANSI/AHRI 495, except as modified herein. Receiver shall be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; thermal well for thermostat; float switch column; external float switches; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be provided with a relief valve of capacity and setting in accordance with ANSI/ASHRAE 15 & 34.

2.4.6.3 Oil Separator

Separator shall be the high efficiency type and be provided with removable flanged head for ease in removing float assembly and removable screen cartridge assembly. Pressure drop through a separator shall not exceed 10 psi during the removal of hot gas entrained oil. Connections to compressor shall be as recommended by the compressor manufacturer. Separator shall be provided with an oil float valve assembly or needle valve and orifice assembly, drain line shutoff valve, sight glass, filter for removal of all particulate sized 10 microns and larger, thermometer and low temperature thermostat fitted to thermal well, and strainer.

2.4.6.4 Oil Reservoir

Reservoir capacity shall equal one charge of all connected compressors. Reservoir shall be provided with an external liquid gauge glass, plugged drain, and isolation valves. Vent piping between the reservoir and the suction header shall be provided with a 5 psi pressure differential relief valve. Reservoir shall be provided with the manufacturer's standard filter on the oil return line to the oil level regulators.

2.4.7 Internal Dampers

Dampers shall be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions shall be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers shall have minimum position stops, be linked together, and have automatic modulation and operate as specified.

2.4.8 Mixing Boxes

Mixing boxes shall match the base unit in physical size and shall include equally-sized flanged openings, each capable of full air flow. Arrangement shall be as indicated.

2.4.9 Cabinet Construction

Casings for the specified unitary equipment shall be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness shall be 20 gauge. Provisions to permit replacement of major unit components shall be

incorporated. Penetrations of cabinet surfaces, including the floor, shall be sealed. Unit shall be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan shall be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. Pan insulation shall be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces shall prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation shall conform to ASTM C1071. Paint and finishes shall comply with the requirements specified in paragraph FACTORY COATING.

2.4.9.1 Indoor Cabinet

Indoor cabinets shall be suitable for the specified indoor service and enclose all unit components.

2.5 ACCESSORIES

2.5.1 Dry-Cooler, Glycol Solution

Unit shall be factory fabricated and tested, packaged, self-contained, complete with casing, propeller or centrifugal type fans, heat rejection coils, appurtenances, and intercomponent piping and wiring. Unit shall be certified by the manufacturer or an independent test laboratory that the unit's ratings meet AHRI 410 the indicated conditions. Unit shall be designed for outdoor installation and comply with the requirements of UL 1995. Unit shall compatible with the solution specified in paragraph "Glycol Solution". Unit shall be fitted with recirculating pump, expansion tank, black steel or Type L copper intercomponent piping, system accessories and controls. Factory assembled piping shall be Type L copper. Cabinet construction shall be in accordance with paragraph "Unitary Equipment Components".

2.5.1.1 Coil

Coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.5.1.2 Fan Section

Fan shall be the centrifugal type in accordance with paragraph "Fans". Motors shall have open dripproof totally enclosed enclosures and be suitable for the indicated service.

2.5.1.3 Pump

Pump and controls shall be mounted within a lockable sheet metal enclosure supported from dry cooler structure (for pump located outside). Pump shall be of the end-suction type with an open dripproof totally enclosed motor.

Pump construction shall be as specified in paragraph "Pumps". Seals shall be mechanical type suitable for ethylene glycol solution up to a 60 percent concentration of glycol, and be rated for 180 degrees F service.

2.5.1.4 Controls

The control system shall be complete with all required accessories for regulating glycol temperature by fan cycling or solid-state variable fan speed. Unit-mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include a control transformer, fan motor starters, solid-state speed control, pump motor starters, time delay start-up, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

2.5.1.5 Glycol Solution

System shall be filled with 40 percent propylene glycol solution.

2.5.2 Gaskets

Gaskets shall conform to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.5.3 Bolts and Nuts

Bolts and nuts shall be in accordance with ASTM A307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.5.4 Bird Screen

Screen shall be 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.6 FINISHES

2.6.1 Factory Coating

2.6.1.1 Equipment and Components

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D520, Type I.

2.6.2 Factory Applied Insulation

Refrigeration equipment shall be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor in accordance with

manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.7 SUPPLEMENTAL COMPONENTS/SERVICES

2.7.1 Condenser Water Piping and Accessories

Condenser water piping and accessories shall be provided and installed in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.7.2 Ductwork

Ductwork shall be provided and installed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.7.3 Temperature Controls

Temperature controls shall be fully coordinated with and integrated into the existing air-conditioning system.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work. Submit a letter, at least 2 weeks prior to beginning construction, including the date the site was visited, confirmation of existing conditions, and any discrepancies found.

3.2 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1 and ASME BPVC SEC IX, the design, fabrication, and installation of the system shall conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.2.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ANSI/ASHRAE 15 & 34. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, drycoolers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of

machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators shall limit vibration to 125 percent at lowest equipment rpm. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Field Applied Insulation

Field applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Refer to Section 01 91 00.00 40 COMMISSIONING for commissioning requirements.

3.4 DEMONSTRATIONS

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. Refer to Section 01 91 00.00 40 COMMISSIONING for additional training requirements.

- a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.
- b. Submit the field posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely

starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

- c. The posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations. Submit 4 complete copies of an operation manual 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 at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.
- d. Submit 4 complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Coordinate requirements for Operation & Maintenance Manuals with Section 01 78 23 OPERATION AND MAINTENANCE DATA and Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION.

-- End of Section --

SECTION 23 82 23.00 40

UNIT VENTILATORS

05/14

PART 1 GENERAL

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS 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.

INTERNATIONAL CODE COUNCIL (ICC)

ICC IFGC (2012) International Fuel Gas Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

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

Record of Existing Conditions

Listing of Product InstallationsSD-02 Shop Drawings

Propeller Unit Heaters; G

SD-03 Product Data; G

Propeller Unit Heaters; G

Vibration Isolation; G

Material, equipment, and fixture list

Propellers

Horizontal Discharge Units

SD-05 Design Data

Connection Diagrams; G

Control Diagrams; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Spare Parts

Record Drawings

1.3 QUALITY ASSURANCE

Submit records of existing conditions consisting of the results of 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.

Provide listing of product installations that includes identification of at least 5 installed units, similar to those proposed for work, that have been in successful service for a minimum period of 5 years. Provide list that includes purchaser, address of installation, service organization, and date of installation.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

Submit product data for vibration isolation components.

Provide control diagrams that show physical and functional relationships of equipment. Provide electrical diagrams that show size, type, and capacity of the systems. Submit pneumatic diagrams for air and gas systems.

Submit connection diagrams indicating the relations and connections. Indicate the general physical layout of all controls, and internal tubing and wiring details on the drawings.

Submit equipment and performance data for Propeller Unit Heaters consisting of system functional flows, safety features, and mechanical automated details. Submit curves indicating tested and certified equipment responses and performance characteristics.

2.2 MANUFACTURED UNITS

Provide material, equipment, and fixture list that includes manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit spare parts list and information meeting referenced standards within this section.

2.2.1 Propeller Unit Heaters-Hot Water and Steam (PUH)

Provide drawings or schedule that include capacity, heating media data and mounting height.

2.2.1.1 Type

Provide suspended type unit heaters, arranged for discharge of air as

indicated.

2.2.1.2 Horizontal Discharge Units

Provide maximum volume in cubic feet per minute (cfm) and face velocity in feet per minute (fpm) for horizontal discharge units as follows:

Volume (cfm)	Velocity (fpm)
Up to 1,000	800
1,001 to 3,000	900
3,001 and over	1,000

Provide adjustable double deflection louvers.

2.2.1.3 Heating Element

Provide manufacturer's standard construction heating elements, rated for standard service of not less than 300 degrees F at 75 pounds per square inch (psi).

2.2.1.4 Casings

Provide casings with smoothly contoured propeller orifice rings constructed of 20-gage or thicker cold-rolled carbon steel. Provide casing surface finish that includes phosphate pretreatment, prime coating, and baked enamel finish.

2.2.1.5 Propellers and Motors

Provide propellers that have not less than four aluminum blades and are dynamically balanced.

Provide horizontal-discharge units with fan inlet safety guard.

Mount motors on elastomer vibration isolators.

2.2.1.6 Control

Control unit heaters by line-voltage thermostats.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Equipment

Install equipment in accordance with manufacturer's recommendations.

3.1.2 Location

Install heaters in compliance with clearance and mounting height requirements of ICC IFGC and NFPA 70.

3.2 FIELD QUALITY CONTROL

Conduct operational tests per manufacturer's instructions.

3.3 CLOSEOUT ACTIVITIES

Submit record drawings providing current factual information including deviations from, and amendments, to the drawings and concealed and visible changes in the work.

Submit 4 copies of the operation and maintenance manuals 30 calendar days prior to testing the system.

Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

-- 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 (2013) 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 1-4 2012; INT 5-7 2013) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. 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 20 00 INTERIOR DISTRIBUTION SYSTEM

Section 26 51 00 INTERIOR LIGHTING

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 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.4.1 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.

1.4.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.5 QUALITY ASSURANCE

1.5.1 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.

1.5.2 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.

1.5.2.1 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.

1.5.2.2 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.

1.6 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.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 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 0.25 inch high normal block style.

1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.11 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.

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 and the additional requirements specified in the technical sections.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

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, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

02/14

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 | (2013) Standard Specification for Hard-Drawn Copper Wire |
| ASTM B8 | (2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM D709 | (2013) 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 1-4 2012; INT 5-7 2013) National Electrical Safety Code |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|------------|---|
| ANSI C80.1 | (2005) American National Standard for Electrical Rigid Steel Conduit (ERSC) |
| ANSI C80.3 | (2005) American National Standard for Electrical Metallic Tubing (EMT) |
| ANSI C80.5 | (2005) American National Standard for Electrical Rigid Aluminum Conduit |
| NEMA FU 1 | (2012) 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 4 | (2010) Terminal Blocks |
| NEMA ICS 6 | (1993; R 2011) Enclosures |
| NEMA KS 1 | (2013) Enclosed and Miscellaneous |

	Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
NFPA 70E	(2012; Errata 2012) Standard for Electrical Safety in the Workplace
NFPA 780	(2014) Standard for the Installation of Lightning Protection Systems
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 2012) Standard for Flexible Metal Conduit
UL 1063	(2006; Reprint Jul 2012) Machine-Tool Wires and Cables
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1660	(2014) Liquid-Tight Flexible Nonmetallic Conduit
UL 198M	(2003; Reprint Feb 2013) Standard for Mine-Duty Fuses
UL 360	(2013; Reprint Aug 2014) Liquid-Tight Flexible Steel Conduit
UL 4248-1	(2007; Reprint Oct 2013) UL Standard for Safety Fuseholders - Part 1: General Requirements
UL 4248-12	(2007; Reprint Dec 2012) UL Standard for Safety Fuseholders - Part 12: Class R

UL 44	(2014; Reprint Jun 2014) Thermoset-Insulated Wires and Cables
UL 486A-486B	(2013; Reprint Feb 2014) Wire Connectors
UL 486C	(2013; Reprint Feb 2014) Splicing Wire Connectors
UL 506	(2008; Reprint Oct 2013) Specialty Transformers
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514B	(2012; Reprint Jun 2014) Conduit, Tubing and Cable Fittings
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint May 2014) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 6A	(2008; Reprint May 2013) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 83	(2014) Thermoplastic-Insulated Wires and Cables

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00.

SD-03 Product Data

Circuit breakers; G, A/E

Switches; G, A/E

Motor controllers; G, A/E

Combination motor controllers; G, A/E

Manual motor starters; G, A/E

SD-06 Test Reports

600-volt wiring test; G, A/E

SD-07 Certificates

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G, A/E

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" or "must" 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. Provide equipment, materials, installation, and workmanship 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 and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide 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 are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that 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 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

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.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 in accordance with NEMA TC 2, UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40(40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Die Cast compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.3.1 Conductors

Provide the following:

- a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.
- b. Conductors No. 8 AWG and larger diameter: stranded.
- c. Conductors No. 10 AWG and smaller diameter: solid.
- d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

- e. All conductors: copper.
- f. Conductors used in fire compartments and crawl spaces shall be suitable for high temperature application (greater than 260 degrees C). High temperature wire should be in accordance with Military Specification ML-W-25038, Type 1.

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

Provide minimum conductor size in accordance with the following:

- a. Branch circuits: No. 12 AWG.
- b. Class 1 remote-control and signal circuits: No. 14 AWG.
- c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.
- d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

2.3.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.3.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

- a. Grounding conductors: Green.
- b. Neutral conductors: White.
- c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.3.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems 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

c. 120/240 volt, single phase: Black and red

2.3.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: 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 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.5 DEVICE PLATES

Provide the following:

- a. UL listed, one-piece device plates for outlets to suit the devices installed.
- b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.
- c. For nonmetallic boxes and fittings, other suitable plates may be provided.
- d. Plates on finished walls: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.
- e. Screws: machine-type with countersunk heads in color to match finish of plate.
- f. Sectional type device plates are not be permitted.
- g. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.6 SWITCHES

2.6.1 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in NEMA enclosure per NEMA ICS 6.

2.7 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch and control center. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.7.1 Fuseholders

Provide in accordance with UL 4248-1.

2.7.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1 time-delay type. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.7.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198M, Class J for zero to 600 amperes and Class CC for zero to 30 amperes.

2.8 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

- a. UL 508, NEMA ICS 1, and NEMA ICS 2.
- b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.
- c. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.
- d. Provide protection for motors from immediate restart by a time adjustable restart relay.
- e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.
- f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.
- g. Safety control devices, such as low and high pressure cutouts, high

temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.

- h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.
- i. Provide selector switch with the means for locking in any position.
- j. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.
- l. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.
- m. Cover of combination motor controller and manual switch or circuit breaker: interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.8.1 Control Wiring

Provide control wiring in accordance with the following:

- a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and passing the VW-1 flame tests included in those standards.
- b. Hinge wire: Class K stranding.
- c. Current transformer secondary leads: not smaller than No. 10 AWG.
- d. Control wire minimum size: No. 14 AWG.
- e. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.
- f. Provide 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

Provide control circuit terminal blocks in accordance with the following:

- a. NEMA ICS 4.
- b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.
- c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.

- d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.
- e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four (4) spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.
- f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.
- g. Submit data showing that any 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: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with 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: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals 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, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide each connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.8.3 Control Circuits

Control circuits: maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers: conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits: provide 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 one fused secondary lead with the other lead grounded.

2.8.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.8.5 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations: heavy duty, oil-tight design.

2.8.6 Pilot and Indicating Lights

Provide LED cluster lamps.

2.9 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection and pilot lights.

2.9.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color: In accordance with NEMA ICS 2.

2.10 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. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.11 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment 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

Provide field fabricated nameplates in accordance with the following:

- a. ASTM D709.
- b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.
- c. Each nameplate inscription: identify the function and, when applicable, the position.
- d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.
- e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- f. Minimum size of nameplates: one by 2.5 inches.
- g. Lettering size and style: a minimum of 0.25 inch high normal block style.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Hazardous Locations

Perform work in hazardous locations, as defined by NFPA 70, 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. Provide conduit with tapered threads.

3.1.2 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: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches.

3.1.2.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.2.2 Fireplace and Crawl Space

Indicate the extent of high temperature wiring and conduit on shop drawing.

3.1.3 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 in crawl space as if exposed.

3.1.3.1 Restrictions Applicable to Aluminum Conduit

- a. Do not install underground or encase in concrete or masonry.
- b. Do not use brass or bronze fittings.
- c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).
- d. Do not install in fireplace or crawl space.

3.1.3.2 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).

3.1.3.3 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).

3.1.3.4 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).

3.1.3.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40.
Plastic coating: extend minimum 6 inches above floor.

3.1.3.6 Fireplace or Crawl Space Conduit

Intermediate metal conduit (IMC); rigid metallic conduit.

3.1.3.7 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit 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. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete

ceiling. Do not cut main reinforcing bars for any 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. 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: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation 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. Where conduit crosses building expansion joints, provide suitable 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.

3.1.3.8 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.

3.1.3.9 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. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.3.10 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: 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.

3.1.4 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: 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, or when installed in hazardous areas and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Provide each box with volume required by NFPA 70 for

number of conductors enclosed in box. Boxes for mounting lighting fixtures: 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: 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; provide readily removable fixtures 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. 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.

3.1.4.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

3.1.4.2 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.

3.1.5 Mounting Heights

Mount motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor.

3.1.6 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.6.1 Marking Strips

Provide marking strips in accordance with the following:

- a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

- b. Use permanent ink for the wire numbers
- c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.
- d. Size marking strips to accommodate the two sets of wire numbers.
- e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.
- f. 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, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.
- g. 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.

3.1.7 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.

3.1.8 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.

3.1.9 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.10 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways.

3.1.11 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 and are provided under the section specifying the associated equipment.

3.1.12 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

3.1.12.1 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.

3.1.12.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

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 test.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation 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: 250,000 ohms.

-- End of Section --

SECTION 26 29 23

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

04/06

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 519 (2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- 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 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
- NEMA ICS 3.1 (2009) Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
- NEMA ICS 6 (1993; R 2011) Enclosures
- NEMA ICS 7 (2006) Adjustable-Speed Drives

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

- MIL-STD-461 (2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

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

47 CFR 15 Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489 (2013; Reprint Mar 2014) Molded-Case
Circuit Breakers, Molded-Case Switches,
and Circuit-Breaker Enclosures

UL 508C (2002; Reprint Nov 2010) Power Conversion
Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, Section
01 91 00.00 40 COMMISSIONING, and Section 26 20 00 INTERIOR DISTRIBUTION
SYSTEM apply to this section with additions and modifications specified
herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and
regulations, shall be certified to comply with the requirements for class A
computing devices and labeled as set forth in part 15.

1.3.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive
(VFD) shall not cause electromagnetic interference to adjacent electrical
or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel shall have surge
protection, included within the panel to protect the unit from damaging
transient voltage surges. Surge arrestor shall be mounted near the
incoming power source and properly wired to all three phases and ground.
Fuses shall not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on
control and sensor wiring installed outdoors and as shown. The inputs and
outputs shall be tested in both normal mode and common mode using the
following two waveforms:

- a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of
1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000
volts and a peak current of 500 amperes.

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

Schematic diagrams; G, A/E

Interconnecting diagrams; G, A/E

Installation drawings; G, A/E

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives; G, A/E

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test

Performance Verification Tests

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan; G, A/E

Factory test results

SD-10 Operation and Maintenance Data

Variable frequency drives, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system shall be warranted by the manufacturer for a period of one year, or the contracted period of any extended warrantee agreed upon by the contractor and the Government, after successful completion of the acceptance test. Any component failing to perform its function as specified and documented shall be repaired or replaced by the contractor at no additional cost to the Government. Items repaired or replaced shall be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in the FAR CLAUSE 52.246-21.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 Maintenance Support

During the warranty period, the Contractor shall provide on-site, on-call maintenance services by Contractor's personnel on the following basis: The service shall be on a per-call basis with 36 hour response. Contractor shall support the maintenance of all hardware and software of the system. Various personnel of different expertise shall be sent on-site depending on the nature of the maintenance service required. Costs shall include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

- a. Input circuit breaker per UL 489 with a minimum of 18,000 amps symmetrical interrupting capacity and door interlocked external operator.
- b. A converter stage per UL 508C shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than .95 lagging under any speed and load condition.
- c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.
- d. The VFD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.
- e. The VFD shall be designed to operate from a 480 volt, plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.
- f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.
- g. Adjustable full-time current limiting shall limit the current to a

- preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.
- h. The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.
 - i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.
 - j. The controller efficiency at any speed shall not be less than 96 percent.
 - k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.
 - l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:
 - 1. Short circuit at controller output
 - 2. Ground fault at controller output
 - 3. Open circuit at controller output
 - 4. Input undervoltage
 - 5. Input overvoltage
 - 6. Loss of input phase
 - 7. AC line switching transients
 - 8. Instantaneous overload
 - 9. Sustained overload exceeding 115 percent of controller rated current
 - 10. Over temperature
 - 11. Phase reversal
 - m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.
 - n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within plus or minus 0.5 percent of

maximum speed without the necessity of a tachometer generator.

- o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.
- p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.
- q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.
- r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:
 - 1. Manual speed potentiometer.
 - 2. Hand-Off-Auto (HOA) switch.
 - 3. Power on light.
 - 4. Drive run power light.
 - 5. Local display.
- s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. PVT to be coordinated with commissioning functional performance testing. Contractor PVTs to be completed prior to commissioning functional performance testing. Refer to Section 01 91 00.00 40 for additional testing and commissioning requirements. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the contracting officer.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the Contracting Officer. Refer to Section 01 91 00.00 40 COMMISSIONING for additional training requirements.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full

instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. The number of training days of instruction furnished shall be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals shall be turned over to the Government at the end of last training session.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. Alarm formats
- e. Failure recovery procedures
- f. Troubleshooting

3.3.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training shall be conducted on site at a location designated by the Government. Provide a one day training session to train 4 engineering personnel in the functional operations of the system. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. System configuration
- e. Alarm formats

- f. Failure recovery procedures
- g. Troubleshooting and repair
- h. Maintenance and calibration
- i. System programming and configuration

-- End of Section --

SECTION 26 42 14.00 10

CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)
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.

ASTM INTERNATIONAL (ASTM)

- | | |
|------------|--|
| ASTM B418 | (2012) Standard Specification for Cast and Wrought Galvanic Zinc Anodes |
| ASTM B843 | (2013) Standard Specification for Magnesium Alloy Anodes for Cathodic Protection |
| ASTM D1248 | (2012) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |

NACE INTERNATIONAL (NACE)

- | | |
|-------------|---|
| NACE SP0169 | (2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems |
| NACE SP0177 | (2014) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems |
| NACE SP0188 | (1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|-----------|---|
| NEMA TC 2 | (2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit |
|-----------|---|

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|---------|--|
| NFPA 70 | (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code |
|---------|--|

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

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

UNDERWRITERS LABORATORIES (UL)

UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013) Metallic Outlet Boxes
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel

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

Drawings; G, AE
Contractor's Modifications; G, AE

SD-03 Product Data

Equipment; G, AE
Spare Parts

SD-06 Test Reports

Tests and Measurements; G, AE
Contractor's Modifications; G, AE

SD-07 Certificates

Cathodic Protection System
Services of "Corrosion Expert"; G, AE

SD-10 Operation and Maintenance Data

Cathodic Protection System
Training Course

1.3 QUALITY ASSURANCE

1.3.1 Services of "Corrosion Expert"

Obtain the services of a "corrosion expert" to supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces.

- a. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has

certification or licensing that includes education and experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract.

- b. The "corrosion expert" shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the "corrosion expert" shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The "corrosion expert" shall supervise installation and testing of all cathodic protection.
- c. Submit evidence of qualifications of the "corrosion expert" including its name and qualifications certified in writing to the Contracting Officer prior to the start of construction. Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations, three (3) or more years old, that have been tested and found satisfactory.

1.3.2 Surge Protection

Approved zinc grounding cells or sealed weatherproof lightning arrestor devices shall be installed across insulated flanges or fittings installed in underground piping as indicated on the drawings. The arrestor shall be gapless, self-healing, solid state type. Zinc anode composition shall conform to ASTM B418, Type II. Lead wires shall be number 6 AWG copper with high molecular weight polyethylene (HMWPE) insulation. The zinc grounding cells shall not be prepackaged in backfill but shall be installed as detailed on the drawings. Lightning arrestors or zinc grounding cells are not required for insulated flanges on metallic components used on nonmetallic piping systems.

1.3.3 Nonmetallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, all metallic components of this pipe system shall be protected with cathodic protection. Detailed drawings of cathodic protection for each component shall be submitted to the Contracting Officer for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

1.3.3.1 Coatings

Coatings for metallic components shall be as required for metallic fittings. Protective covering (coating and taping) shall be completed and tested on each metallic component (such as valves, hydrants and fillings). This covering shall be as required for underground metallic pipe. Each test shall be witnessed by the Contracting Officer. Coatings shall be selected, applied, and inspected as specified in these specifications. The use of nonmetallic pipe does not change other requirements of the specifications. Any deviations due to the use of nonmetallic pipe shall be submitted for approval.

1.3.3.2 Tracer Wire

When a nonmetallic pipe line is used to extend or add to an existing metallic line, an insulated No. 8 AWG copper wire shall be thermit-welded to the existing metallic line and run the length of the new nonmetallic line. This wire shall be used as a locator tracer wire and to maintain continuity to any future extensions of the pipe line.

1.3.4 Drawings

Submit six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, results of system design calculations including soil-resistivity, installation instructions and certified test data showing location of anodes and stating the maximum recommended anode current output density. Include in the detail drawings complete wiring and schematic diagrams, insulated fittings, test stations, permanent reference cells, and bonding and any other details required to demonstrate that the system has been coordinated and will function properly as a unit. Locations shall be referenced to two (2) permanent facilities or mark points.

1.4 DELIVERY, STORAGE, AND HANDLING

Storage area for magnesium anodes will be designated by the Contracting Officer. If anodes are not stored in a building, tarps or similar protection should be used to protect anodes from inclement weather. Packaged anodes, damaged as a result of improper handling or being exposed to rain, shall be resacked and the required backfill added.

1.5 EXTRA MATERIALS

After approval of shop drawings, and not later than three (3) months prior to the date of beneficial occupancy, furnish spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than six (6) months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. One (1) spare anode of each type shall be furnished. In addition, supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice kits and connectors, corrosion test stations, and any other components not listed above.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete, operating, sacrificial anode cathodic protection system in complete compliance with NFPA 70, with all applicable Federal, State, and local regulations and with the minimum requirements of this contract.

- a. In addition to the minimum requirements of these specifications, construction of gas pipelines and associated cathodic protection systems shall be in compliance with 49 CFR 192 and
- b. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Gas lines and their connectors. The

cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified.

- c. Submit an itemized list of equipment and materials including item number, quantity, and manufacturer of each item, within 30 days after receipt of notice to proceed. The list shall be accompanied by a description of procedures for each type of testing and adjustments, including testing of coating for thickness and holidays. Installation of materials and equipment shall not commence until this submittal is approved. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing another pipe shall have a test station. The cathodic protection shall be provided on Gas pipes.
- d. Submit proof that the materials and equipment furnished under this section conform to the specified requirements contained in the referenced standards or publications. The label or listing by the specified agency will be acceptable evidence of such compliance.
- e. Before final acceptance of the cathodic protection system, submit 6 copies of operating manuals outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.
- f. Submit 6 copies of maintenance manuals, listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single-line diagrams for the system as installed; instructions in making pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring; instructions for dielectric connections, interference and sacrificial anode bonds; instructions shall include precautions to ensure safe conditions during repair of pipe or other metallic systems. The instructions shall be neatly bound between permanent covers and titled "Operating and Maintenance Instructions." These instructions shall be submitted for the Contracting Officer's approval. The instructions shall include the following:
 - (1) As-built drawings, to scale, of the entire system, showing the locations of the piping, location of all anodes and test stations, locations of all insulating joints, and structure-to-soil potential test points as measured during the tests required by paragraph TESTS AND MEASUREMENTS. Each test point shall be given a unique alphanumeric identification that is cross referenced to the data sheets.
 - (2) Recommendations for maintenance testing, including instructions in making pipe-to-reference cell potential measurements and frequency of testing.
 - (3) All maintenance and operating instructions and nameplate data shall be in English.
 - (4) Instructions shall include precautions to insure safe conditions during repair of pipe system.

2.1.1 Contractor's Modifications

The specified system is based on a complete system with magnesium sacrificial anodes. The Contractor may modify the cathodic protection system after review of the project, site verification, and analysis, if the proposed modifications include the anodes specified and will provide better overall system performance.

- a. Submit six copies of detail drawings showing proposed changes in location, scope of performance indicating any variations from, additions to, or clarifications of contract drawings. Show proposed changes in anode arrangement, anode size and number, anode materials and layout details, conduit size, wire size, mounting details, wiring diagram, method for electrically-isolating each pipe, and any other pertinent information to proper installation and performance of the system. The modifications shall be fully described, shall be approved by the Contracting Officer, and shall meet the following criteria.
- b. The proposed system shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolts with reference to a saturated copper-copper sulfate reference cell on the underground components of the piping or other metallic surface. Take resistivity measurements of the soil in the vicinity of the pipes and ground bed sites. Based upon the measurements taken, the current and voltage shall be required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential shall be obtained over 95 percent of the metallic area. The anode system shall be designed for a life of twenty-five (25) years of continuous operation.
- c. Submit final report regarding Contractor's modifications. The report shall include pipe-to-soil measurements throughout the affected area, indicating that the modifications improved the overall conditions, and current measurements for anodes. The following special materials and information are required: taping materials and conductors; zinc grounding cell, installation and testing procedures, and equipment; coating material; system design calculations for anode number, life, and parameters to achieve protective potential; backfill shield material and installation details showing waterproofing; bonding and waterproofing details; insulated resistance wire; exothermic weld equipment and material.

2.1.2 Summary of Services Required

The scope of services shall include, but shall not be limited to, the following:

- a. Close-interval potential surveys.
- b. Cathodic Protection Systems.
- c. System testing.
- d. Casing corrosion control.
- e. Interference testing.
- f. Training.

- g. Operating and maintenance manual.
- h. Insulator testing and bonding testing.
- i. Coating and holiday testing to be submitted within 45 days of notice to proceed.

2.1.3 Tests of Components

Perform a minimum of four (4) tests at each metallic component in the piping system. Two (2) measurements shall be made directly over the anodes and the other two (2) tests shall be over the outer edge of the component, but at the farthest point from the anodes. Structure and pipes shall be shown with the cathodic protection equipment. All components of the cathodic protection system shall be shown on drawings, showing their relationship to the protected structure or component. A narrative shall describe how the cathodic protection system will work and provide testing at each component. Components requiring cathodic protection shall include but not be limited to the following:

- a. Pipes under the floor slab or foundations.
- b. PIV.
- c. Shutoff valves.
- d. Metallic pipe extended from aboveground locations.
- e. Each connector or change-of-direction device.
- f. Any metallic pipe component or section.
- g. Backflow preventer.
- h. Culvert.

2.1.4 Electrical Potential Measurements

All potential tests shall be made at a minimum of 10 foot intervals witnessed by the Contracting Officer. Submittals shall identify test locations on separate drawing, showing all metal to be protected and all cathodic protection equipment. Test points equipment and protected metal shall be easily distinguished and identified.

2.1.5 Achievement of Criteria for Protection

All conductors, unless otherwise shown, shall be routed to or through the test stations. Each system provided shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolt potentials with reference to a saturated copper-copper-sulfate reference cell on all underground components of the piping. Based upon the measurements taken, the current and voltage of the anodes should be adjusted as required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential should be obtained over 95 percent of the metallic area. This must be achieved without the "instant off" potential exceeding 1150 millivolts. Testing will be witnessed by the Contracting Officer. Provide additional anodes if required to achieve the minus 850 millivolts "instant off". Although

acceptance criteria of the cathodic protection systems are defined in NACE SP0169, for this project the "instant off" potential of minus 850 millivolts is the only acceptable criteria.

2.1.6 Metallic Components on Nonmetallic Systems and Typicals

2.1.6.1 Metallic Components

As a minimum, protect each metallic component with two (2) magnesium anodes. This number of anodes is required to achieve minus 850 millivolts "instant off" potential on the metallic area and at the same time not provide overvoltage above 1150 millivolts "instant off." As a minimum, the magnesium anode unpackaged weight shall be 9 pounds. The magnesium anodes shall be located on each side of the metallic component and routed through a test station.

2.1.6.2 Fire Hydrants

Fire hydrant pipe components shall have a minimum of two (2) anodes. These magnesium anodes shall have an unpackaged weight of 17 pounds.

2.1.6.3 Pipe Under Concrete Slab

Pipe under concrete slab shall have a minimum of 2 magnesium anodes. These magnesium anodes shall have an unpackaged weight of 9 pounds. Pipe under concrete slab shall have 1 permanent reference electrodes located under the slab. One (1) permanent reference electrode shall be located where the pipe enters the concrete slab. All conductors shall be routed to a test station.

2.1.6.4 Valves

Each valve shall be protected with 1 magnesium anode. The magnesium anode shall have an unpackaged weight of 9 pounds.

2.1.6.5 Metallic Pipe Component or Section

Each section of metallic pipe shall be protected with 2 magnesium anodes. The magnesium anodes shall have an unpackaged weight of 9 pounds.

2.1.6.6 Connectors or Change-of-Direction Devices

Each change-of-direction device shall be protected with 2 magnesium anodes. The magnesium anode shall have an unpackaged weight of 9 pounds.

2.1.7 Metallic Component Coating

Coatings for metallic components shall be as required for metallic fittings as indicated. This will include fire hydrants, T's, elbows, valves, etc. Coatings shall be selected, applied, and inspected as specified in these specifications. All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 7 mil. The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

2.2 MAGNESIUM ANODES

Install a minimum of 2 anodes on the Pipe system. See Paragraph METALLIC COMPONENTS ON NONMETALLIC SYSTEMS AND TYPICALS for additional anodes under

slab.

2.2.1 Anode Composition

Anodes shall be of high-potential magnesium alloy, made of primary magnesium obtained from sea water or brine, and not made from scrap metal. Magnesium anodes shall conform to ASTM B843 and to the following analysis (in percents) otherwise indicated:

Aluminum, max.	0.010
Manganese, max.	0.50 to 1.30
Zinc	0.05
Silicon, max.	0.05
Copper, max.	0.02
Nickel, max.	0.001
Iron, Max.	0.03
Other impurities, max.	0.05 each or 0.3 max. total
Magnesium	Remainder

Furnish spectrographic analysis on samples from each heat or batch of anodes used on this project.

2.2.2 Dimensions and Weights

Dimensions and weights of anodes shall be approximately as follows:

TYPICAL MAGNESIUM ANODE SIZE (Cross sections may be round, square, or D shaped)			
Nominal Weight (lbs)	Approx. Size (inch)	Nominal Gross Weight (lbs) Packaged in Backfill	Nominal Package Dimensions (inch)
3	3 X 3 X 5	8	5-1/4 X 5-1/4 X 8
5	3 X 3 X 8	13	5-1/4 X 5-1/4 X 11-1/4
9	3 X 3 X 14	27	5-1/4 X 20
12	4 X 4 X 12	32	7-1/2 X 18
17	4 X 4 X 17	45	7-1/2 X 24
32	5 X 5 X 20-1/2	68	8-1/2 X 28
50	7 X 7 X 16	100	10 X 24

2.2.3 Packaged Anodes

Provide anodes in packaged form with the anode surrounded by specially-prepared quick-wetting backfill and contained in a water permeable cloth or paper sack. Anodes shall be centered by means of spacers in the backfill material. The backfill material shall have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulphate	5
Total	100

2.2.4 Zinc Anodes

Zinc anodes shall conform to ASTM B418, Type II.

2.2.5 Connecting Wire

2.2.5.1 Wire Requirements

Wire shall be No. 12 AWG solid copper wire, not less than 10 feet long, unspliced, complying with NFPA 70, Type TW insulation. Connecting wires for magnesium anodes shall be factory installed with the place or emergence from the anode in a cavity sealed flush with a dielectric sealing compound.

Connecting wires for zinc anodes shall be factory installed with the place of connection to the protruding steel core completely sealed with a dielectric material.

2.2.5.2 Anode Header Cable

Cable for anode header and distribution shall be No. 2 AWG stranded copper wire with type CP high molecular weight polyethylene, 7/64 inch thick insulation, 600-volt rating.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Electrical Wire

Wire shall be No. 12 AWG stranded copper wire with NFPA 70, Type TW insulation. Polyethylene insulation shall comply with the requirements of ASTM D1248 and shall be of the following types, classes, and grades:

High-molecular weight polyethylene shall be Type I, Class C, Grade E5.

High-density polyethylene shall be Type III, Class C, Grade E3.

2.3.1.1 Wire Splicing

Connecting wire splicing shall be made with copper compression connectors or exothermic welds, following instructions of the manufacturer. Single

split-bolt connections shall not be used. Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joints and epoxy potting compound shall be as specified below.

2.3.1.2 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70, Type TW or RHW-USE with outer covering or polyethylene insulation.

2.3.1.3 Resistance Wire

Resistance wire shall be AWG No. 16 or No. 22 nickel-chromium wire.

2.3.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Non metallic conduit shall conform to NEMA TC 2.

2.3.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

2.3.4 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 1/2-inch thick. Coating compound shall be cold-applied coal-tar base mastic. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.3.5 Backfill Shields

Shields shall consist of approved pipeline wrapping or fiberglass-reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose and installed in accordance with the manufacturer's recommendations. When joint bonds are required, due to the use of mechanical joints, the entire joint shall be protected by the use of a kraft paper joint cover. The joint cover shall be filled with poured-in, hot coat-tar enamel.

2.3.6 Epoxy Potting Compound

Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

2.3.7 Test Stations

Stations shall be of the aboveground and shall be the standard product of a recognized manufacturer. Test stations shall be complete with an insulated terminal block having the required number of terminals. The test station shall be provided with a lockable over and shall have an embossed legend, "C.P. Test." A minimum of one (1) test station shall be provided each component of the pipe. A minimum of six (6) terminals shall be provided in each test station. A minimum of two (2) leads are required to the metallic pipe from each test station. Other conductors shall be provided for each anode, other foreign pipe, and reference cells as required. Test stations may be constructed of nonmetallic materials. However, if nonmetallic

materials are utilized, as a minimum, the materials shall be resistant to damage from ultraviolet radiation, contain good color retention qualities, contain high strength qualities, and be resistant to accidental or vandalistic impacts that might be normally encountered in the environment for which they are to be installed. The test stations shall be listed for the particular application for which they are to be utilized.

2.3.8 Joint and Continuity Bonds

Bonds shall be provided across all joints in the metallic gas lines, across any electrically discontinuous connections and all other pipes and structures with other than welded or threaded joints that are included in this cathodic protection system. Unless otherwise specified in the specifications, bonds between structures and across joints in pipe with other than welded or threaded joints shall be No. 8 AWG stranded copper cable with polyethylene insulation. Bonds between structures shall contain sufficient slack for any anticipated movement between structures. Bonds across pipe joints shall contain a minimum of 4 inch of slack to allow for pipe movement and soil stress. Bonds shall be attached by exothermic welding. Exothermic weld areas shall be insulated with coating compound and approved, and witnessed by the Contracting Officer. Continuity bonds shall be installed as necessary to reduce stray current interference. Additional joint bondings shall be accomplished where the necessity is discovered during construction or testing or where the Contracting Officer's representative directs that such bonding be done. Joint bonding shall include all associated excavation and backfilling. There shall be a minimum of two (2) continuity bonds between each structure and other than welded or threaded joints. Test for electrical continuity across all joints with other than welded or threaded joints and across all metallic portions or components. Provide bonding as required and as specified above until electrical continuity is achieved. Submit bonding test data for approval.

2.3.9 Resistance Bonds

Resistance bonds should be adjusted as outlined in this specification. Alternate methods may be used if they are approved by the Contracting Officer.

2.3.10 Stray Current Measurements

Stray current measurements should be performed at each test station. Stray currents resulting from lightning or overhead alternating current (AC) power transmission systems shall be mitigated in accordance with NACE SP0177.

2.3.11 Electrical Isolation of Structures

As a minimum, isolating flanges or unions shall be provided at the following locations:

- a. Connection of new metallic piping or components to existing piping.
- b. Pressure piping under floor slab to a building.

Isolation shall be provided at metallic connection of all lines to existing system and where connecting to a building. Additionally, isolation shall be provided between water and/or gas line; and foreign pipes that cross the new lines within 10 feet. Isolation fittings, including isolating flanges and couplings, shall be installed aboveground or in a concrete pit.

2.3.11.1 Electrically Isolating Pipe Joints

Electrically isolating pipe joints shall be of a type that is in regular factory production.

2.3.11.2 Electrically Conductive Couplings

Electrically conductive couplings shall be of a type that has a published maximum electrical resistance rating given in the manufacturer's literature. Cradles and seals shall be of a type that is in regular factory production made for the purpose of electrically insulating the carrier pipe from the casing and preventing the incursion of water into the annular space.

2.3.11.3 Insulating Joint Testing

A Model 601 Insulation Checker, as manufactured by "Gas Electronics" or an approved equal, shall be used for insulating joint (flange) electrical testing.

2.3.12 Underground Structure Coating

This coating specification shall take precedence over any other project specification and drawing notes, whether stated or implied, and shall also apply to the pipeline or tank supplier. No variance in coating quality shall be allowed by the Contractor or Base Construction Representative without the written consent of the designer. All underground metallic pipelines and tanks to be cathodically protected shall be afforded a good quality factory-applied coating. This includes all carbon steel, cast-iron and ductile-iron pipelines or vessels. Coatings shall be selected, applied, and inspected as specified. If non-metallic pipelines are installed, all metallic fittings on pipe sections shall be coated in accordance with this specification section.

- a. The nominal thickness of the metallic pipe joint or other component coating shall be 24 mils, plus or minus 5 percent.
- b. Pipe and joint coating for factory applied or field repair material shall be applied as recommended by the manufacturer and shall be one of the following:
 - (1) Continuously extruded polyethylene and adhesive coating system.
 - (2) Polyvinyl chloride pressure-sensitive adhesive tape.
 - (3) High density polyethylene/bituminous rubber compound tape.
 - (4) Butyl rubber tape.
 - (5) Coal tar epoxy.

2.3.12.1 Field Joints

All field joints shall be coated with materials compatible with the pipeline coating compound. The joint coating material shall be applied to an equal thickness as the pipeline coating. Unbonded coatings shall not be used on these buried metallic components. This includes the elimination of all unbonded polymer wraps or tubes. Once the pipeline or vessel is set in the trench, an inspection of the coating shall be conducted. This inspection shall include electrical holiday detection. Any damaged areas of the coating shall be properly repaired. The Contracting Officer shall be asked to witness inspection of the coating and testing using a holiday

detector.

2.3.12.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE SP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer's representative to determine suitability of the detector. All labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

2.3.12.2.1 Protective Covering for Aboveground Piping System

Finish painting shall conform to the applicable paragraph of SECTION: 09 90 00 PAINTS AND COATINGS and as follows:

2.3.12.2.2 Ferrous Surfaces

Shop-primed surfaces shall be touched-up with ferrous metal primer. Surfaces that have not been shop-primed shall be solvent-cleaned. Surfaces that contain loose rust, loose mil scale, and other foreign substances shall be mechanically-cleaned by power wire-brushing and primed with ferrous metal primer. Primed surface shall be finished with two (2) coats of exterior oil paint and vinyl paint. Coating for each entire piping service shall be an approved pipe line wrapping having a minimum coating resistance of 50,000 Ohms per square foot.

2.3.13 Resistance Wire

Wire shall be No. 16 or No. 22 nickel-chromium wire with TW insulation.

2.3.14 Electrical Connections

Electrical connections shall be done as follows:

- a. Exothermic welds shall be "Cadweld",. Use of this material shall be in strict accordance with the manufacturer's recommendations.
- b. Electrical-shielded arc welds shall be approved for use on steel pipe by shop drawing submittal action.
- c. Brazing shall be as specified in Paragraph: Lead Wire Connections.

2.3.15 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

2.3.16 Permanent Reference Electrodes

Permanent reference electrodes shall be Cu-CuSO4 electrodes suitable for direct burial. Electrodes shall be guaranteed by the supplier for 15 years' service in the environment in which they shall be placed. Electrodes shall be installed directly beneath pipe, or metallic component.

2.3.17 Casing

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing, and the annular space sealed and filled with an approved corrosion inhibiting product against incursion of water.

PART 3 EXECUTION

3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground pipe shall be in accordance with NACE SP0169 and as specified below.

3.1.1 Iron and Steel

The following method a. shall be used for testing cathodic protection voltages. If more than one method is required, method b. shall be used.

- a. A negative voltage of at least minus 850 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode connecting the earth (electrolyte) directly over the underground component. Determination of this voltage shall be made with the cathodic protection system in operation. Voltage drops shall be considered for valid interpretation of this voltage measurement. A minimum of minus 850 millivolts "instant off" potential between the underground component being tested and the reference cell shall be achieved over 95 percent of the area of the structure. Adequate number of measurements shall be obtained over the entire structure, pipe, tank, or other metallic component to verify and record achievement of minus 850 millivolts "instant off." This potential shall be obtained over 95 percent of the total metallic area without the "instant off" potential exceeding 1200 millivolts.
- b. A minimum polarization voltage shift of 100 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth directly over the underground component. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay. Measurements achieving 100 millivolts decay shall be made over 95 percent of the metallic surface being protected.
- c. For any metallic component, a minimum of four (4) measurements shall be made using subparagraph a., above, and achieving the "instant off" potential of minus 850 millivolts. Two (2) measurements shall be made over the anodes and two (2) measurements shall be made at different locations near the component and farthest away from the anode.

3.1.2 Aluminum

Aluminum underground component shall not be protected to a potential more negative than minus 1200 millivolts, measured between the underground component and a saturated copper-copper sulphate reference electrode

contacting the earth, directly over the metallic component. Resistance, if required, shall be inserted in the anode circuit within the test station to reduce the potential of the aluminum to a value which will not exceed a potential more negative than minus 1200 millivolts. Voltage shift criterion shall be a minimum negative polarization shift of 100 millivolts measured between the metallic component and a saturated copper-copper sulphate reference electrode contacting the earth, directly over the metallic component. The polarization voltage shift shall be determined as outlined for iron and steel.

3.1.3 Copper Piping

For copper piping, the following criteria shall apply: A minimum of 100 millivolts of cathodic polarization between the structure surface and a stable reference electrode contacting the electrolyte. The polarization voltage shift shall be determined as outlined for iron and steel.

3.2 TRENCHING AND BACKFILLING

Perform trenching and backfilling in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. In the areas of the anode beds, all trees and underbrush shall be cleared and grubbed to the limits shown or indicated. In the event rock is encountered in providing the required depth for anodes, determine an alternate approved location and, if the depth is still not provided, submit an alternate plan to the Contracting Officer. Alternate techniques and depths must be approved prior to implementation.

3.3 INSTALLATION

3.3.1 Anode Installation

Unless otherwise authorized, installation shall not proceed without the presence of the Contracting Officer. Anodes of the size specified shall be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system shall be designed for a life of 25 years of continuous operation. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 6 inch layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 5 gallons of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 6 inch above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

3.3.1.1 Single Anodes

Single anodes, spaced as shown, shall be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

3.3.1.2 Groups of Anodes

Groups of anodes, in quantity and location shown, shall be connected to an anode header cable. The anode header cable shall make contact with the structure to be protected only through a test station. Anode lead connection to the anode header cable shall be made by an approved crimp connector or exothermic weld and splice mold kit with appropriate potting compound.

3.3.1.3 Welding Methods

Connections to ferrous pipe shall be made by exothermic weld methods manufactured for the type of pipe supplied. Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

3.3.2 Anode Placement - General

Packaged anodes shall be installed completely dry, and shall be lowered into holes by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The hole shall be backfilled with fine soil in 6 inch layers and each layer shall be hand-tamped around the anode. Care must be exercised not to strike the anode or lead wire with the tamper. If immediate testing is to be performed, water shall be added only after backfilling and tamping has been completed to a point 6 inch above the anode. Approximately 2 gallons of water may be poured into the hole. After the water has been absorbed by the soil, backfilling and tamping may be completed to the top of the hole. Anodes shall be installed as specified or shown. In the event a rock strata is encountered prior to achieving specified augered-hole depth, anodes may be installed horizontally to a depth at least as deep as the bottom of the pipe, with the approval of the Contracting Officer.

3.3.3 Underground Pipeline

Anodes shall be installed at a minimum of 8 feet and a maximum of 10 feet from the line to be protected.

3.3.4 Installation Details

Details shall conform to the requirements of this specification. Details shown on the drawings are indicative of the general type of material required, and are not intended to restrict selection to material of any particular manufacturer.

3.3.5 Lead Wire Connections

3.3.5.1 Underground Pipeline (Metallic)

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires shall be connected to a test station and buried a minimum of 24 inch in depth. The cable shall be No. 10 AWG, stranded copper, polyethylene or RHW-USE insulated cable. The cable shall make contact with the structure only through a test station. Resistance wire shall be installed between the cable and the pipe cable, in the test station, to reduce the current output, if required. Anode connections, except in the test station, shall be made with exothermic welding process, and shall be insulated by means of at least three (3) layers of electrical

tape; and all lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin. Lead wire-to-structure connections shall be accomplished by an exothermic welding process. All welds shall be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant or material compatible with the coating shall be placed over the weld connection and shall be of such diameter as to cover the exposed metal adequately.

3.3.5.2 Resistance Wire Splices

Resistance wire connections shall be accomplished with silver solder and the solder joints wrapped with a minimum of three (3) layers of pressure-sensitive tape. Lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin.

3.3.6 Location of Test Stations

Provide buried insulating joints with test wire connections brought to a test station. Reference all test stations with GPS coordinates. Locate other test stations as follows:

- a. At 1,000-foot intervals or less.
- b. Where the pipe or conduit crosses any other metal pipe.
- c. At both ends of casings under roadways and railways.
- d. Where both sides of an insulating joint are not accessible above ground for testing purposes.

3.3.7 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints shall be made electrically continuous by means of a bonding connection installed across the joint.

3.4 ELECTRICAL ISOLATION OF STRUCTURES

3.4.1 Isolation Joints and Fittings

Isolating fittings, including main line isolating flanges and couplings, shall be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they shall be fitted with a paper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel. Isolating fittings in lines entering buildings shall be located at least 12 inch above grade of floor level, when possible. Isolating joints shall be provided with grounding cells to protect against over-voltage surges or approved surge protection devices. The cells shall provide a low resistance across isolating joint without excessive loss of cathodic current.

3.4.2 Gas Distribution Piping

Electrical isolation shall be provided at each building riser pipe to the pressure regulator, at all points where a short to another structure or to a foreign structure may occur, and at other locations as indicated on the drawings.

3.5 TESTS AND MEASUREMENTS

Submit test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, casing and interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. Submit a certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.

3.5.1 Baseline Potentials

Each test and measurement will be witnessed by the Contracting Officer. Notify the Contracting Officer a minimum of five (5) working days prior to each test. After backfill of the pipe, the static potential-to-soil of the pipe shall be measured. The locations of these measurements shall be identical to the locations specified for pipe-to-reference electrode potential measurements. The initial measurements shall be recorded.

3.5.2 Isolation Testing

Before the anode system is connected to the pipe, an isolation test shall be made at each isolating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective shall be reported to the Contracting Officer.

3.5.2.1 Insulation Checker

A Model 601 insulation checker, as manufactured by "Gas Electronics", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. Testing shall conform to the manufacturer's operating instructions. Test shall be witnessed by the Contracting Officer. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault shall be determined from the instructions, and the joint shall be repaired. If an isolating joint is located inside a vault, the pipe shall be sleeved with insulator when entering and leaving the vault.

3.5.2.2 Cathodic Protection Meter

A Model B3A2 cathodic protection meter, as manufactured by "M.C. Miller", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. This test shall be performed in addition to the Model 601 insulation checker. Continuity is checked across the isolation joint after the test lead wire is shorted together and the meter adjusted to scale. A full-scale deflection indicates the system is shorted at some location. The Model 601 verifies that the particular insulation under test is good and the Model B3A2 verifies that the system is isolated. If the system is shorted, further testing shall be performed to isolate the location of the short.

3.5.3 Anode Output

As the anodes or groups of anodes are connected to the pipe, current output shall be measured with an approved clamp-on milliammeter, calibrated shunt

with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The values obtained and the date, time, and location shall be recorded.

3.5.4 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulphate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded. No less than eight (8) measurements shall be made over any length of line or component. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

3.5.5 Location of Measurements

3.5.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Pipe-to-soil potential measurements shall be made at intervals not exceeding 5 feet. The Contractor may use a continuous pipe-to-soil potential profile in lieu of 5 foot interval pipe-to-soil potential measurements. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line adjacent to the riser. Potentials shall be plotted versus distance to an approved scale. Locations where potentials do not meet or exceed the criteria shall be identified and reported to the Contracting Officer's representative.

3.5.5.2 Casing Tests

Before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected.

3.5.5.3 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes in cooperation with the owner of the foreign pipes. A full report of the tests giving all details shall be made. Stray current measurements shall be performed at all isolating locations and at locations where the new pipeline crosses foreign metallic pipes; results of stray current measurements shall also be submitted for approval. The method of measurements and locations of measurements shall be submitted for approval. As a minimum, stray current measurements shall be performed at the following locations:

- a. Connection point of new pipeline to existing pipeline.
- b. Crossing points of new pipeline with existing lines.

3.5.5.4 Holiday Test

Any damage to the protective covering during transit and handling shall be repaired before installation. After field-coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE SP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective covering shall be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor. The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.5.5.5 Recording Measurements

All pipe-to-soil potential measurements, including initial potentials where required, shall be recorded. Locate, correct and report to the Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements shall be taken on as many pipes as necessary to determine the extent of protection or to locate short-circuits.

3.6 TRAINING COURSE

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Submit the proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions. At least 14 days prior to date of proposed conduction of the training course, the training course curriculum shall be submitted for approval, along with the proposed training date. Training shall consist of demonstration of test equipment, providing forms for test data and the tolerances which indicate that the system works.

3.7 SYSTEM TESTING

Submit a report including potential measurements taken at adequately-close intervals to establish that minus 850 millivolts potential, "instant-off" potential, is provided, and that the cathodic protection is not providing interference to other foreign pipes causing damage to paint or pipes. The report shall provide a narrative describing how the criteria of protection is achieved without damaging other pipe or structures in the area.

3.8 SEEDING

Seeding shall be done as directed, in all unsurfaced locations disturbed by this construction. In areas where grass cover exists, it is possible that sod can be carefully removed, watered, and stored during construction operations, and replaced after the operations are completed since it is

estimated that no section of pipeline should remain uncovered for more than two (2) days. The use of sod in lieu of seeding shall require approval by the Contracting Officer.

3.9 CLEANUP

The Contractor is responsible for cleanup of the construction site. All paper bags, wire clippings, etc., shall be disposed of as directed. Paper bags, wire clippings and other waste shall not be put in bell holes or anodes excavation.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING

07/07

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 in the text by the basic designation only.

ILLUMINATING ENGINEERING SOCIETY (IES)

- | | |
|-----------|---|
| IES LM-79 | (2008) Electrical and Photometric Measurements of Solid-State Lighting Products |
| IES LM-80 | (2008) Measuring Lumen Maintenance of LED Light Sources |
| IES TM-21 | (2011) Projecting Long Term Lumen Maintenance of LED Light Sources |

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

- | | |
|-----------|------------------------------|
| IES HB-10 | (2011) IES Lighting Handbook |
|-----------|------------------------------|

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|----------|---|
| IEEE 100 | (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms |
| IEEE C2 | (2012; Errata 2012; INT 1-4 2012; INT 5-7 2013) National Electrical Safety Code |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|-------------|---|
| NEMA 250 | (2008) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA C82.77 | (2002) Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|---------|--|
| NFPA 70 | (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code |
|---------|--|

UNDERWRITERS LABORATORIES (UL)

- | | |
|---------|---|
| UL 1598 | (2008; Reprint Oct 2012) Luminaires |
| UL 844 | (2012) Standard for Luminaires for Use in |

Hazardous (Classified) Locations

UL 8750

(2009; Reprint May 2014) UL Standard for
Safety Light Emitting Diode (LED)
Equipment for Use in Lighting Products

1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

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. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SYSTEM DESCRIPTION

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES HB-10, as applicable, for the lighting system specified.

SD-03 Product Data

LED lighting fixtures; G

Emergency lighting equipment; G

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.6 QUALITY ASSURANCE

1.6.1 LED Light Source - IES LM-80 Test Report

Submit report on manufacturer's standard production LED package, array, or module. Submittal shall include:

- a. Testing agency, report number, date, type of equipment, and LED light source being tested.
- b. All data required by IES LM-80.

1.6.1.1 Test Laboratories

Test laboratories for the IES LM-79 and IES LM-80 test reports shall be one of the following:

- a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program.
- b. One of the qualified labs listed on the Department of Energy - Energy Efficiency & Renewable Energy, Solid-State Lighting web site.
- c. A manufacturer's in-house lab that meets the following criteria:
 1. Manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires and the manufacturer's lab has been successfully certifying these fixtures for a minimum of 15 years.
 2. Annual equipment calibration including photometer calibration in accordance with National Institute of Standards and Technology.

1.6.2 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.

1.6.3 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.

1.6.3.1 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.

1.6.3.2 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.

1.7 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.

1.7.1 LED Luminaire Warranty

Provide Luminaire Useful Life Certificate.

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.

- a. Provide a written five year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

1. Finish warranty shall include warranty against failure and against substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

2. Material warranty shall include:

- (a) All power supply units (drivers).

- (b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

- b. Warranty period must begin on date of beneficial occupancy. Contractor shall provide the Contracting Officer signed warranty certificates prior to final payment.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, luminaire controls, or associated equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 LED LUMINAIRES

UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. All luminaires of the same type shall be provided by the same manufacturer. Luminaires must be specifically designed for use with the ballast, generator or power supply and light source provided.

2.2.1 LED Luminaires

NEMA ANSLG C78.377 Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum lumens requirements as indicated on plans:

LED luminaires must also meet the following minimum requirements:

- a. Luminaires must have a minimum 5 year manufacturer's warranty.
- b. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.
- c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- d. Luminaire must be listed with the DesignLights Consortium 'Qualified Products List'.
- e. Provide Department of Energy 'Lighting Facts' label for each luminaire.

2.2.2 Luminaires for Hazardous Locations

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.3 POWER SUPPLIES (DRIVERS)

2.3.1 LED Power Supplies (Drivers)

UL 8750 LED power supplies (drivers) must be electronic, UL Class 1, constant-current type and comply with the following requirements:

- a. Output power (watts) and output current (mA) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.
- b. Power Factor (PF) greater than or equal to .90.
- c. Total Harmonic Distortion (THD) of less than 20 percent.
- d. Class A sound rating.
- e. Operable at input voltage of 120-277 volts at 60 hertz.
- f. Minimum 5 year manufacturer's warranty.
- g. RoHS compliant.
- h. Integral thermal protection that reduces output power if case temperature exceeds 185 degrees F.
- i. UL listed for dry or damp locations typical of interior

installations.

- j. Non-dimming as indicated in luminaire schedule.
- k. Constant light output function to increase output current over life of device.

2.4 LAMPS

Provide type and wattage as indicated in luminaire schedule on project plans.

2.4.1 Light Emitting Diode (LED) Lamps

- a. Corrected Color Temperature (CCT) as indicated on plans.
- b. Minimum Color Rendering Index (CRI) as indicated on plans.
- c. High power, white light output utilizing phosphor conversion (PC) process.
- d. RoHS compliant.

2.5 LED EMERGENCY SYSTEM

Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to the number of lamps shown for each system for 90 minutes at a minimum of 2100 lumens output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years.

2.6 EQUIPMENT IDENTIFICATION

2.6.1 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.

2.6.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and driver according to proper lamp type.

All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.7 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 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Emergency Lighting

Wire battery pack emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section. Refer to Section 01 91 00.00 40 for additional demonstration, testing and training requirements.

-- End of Section --

SECTION 28 31 00.00 10

FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP
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.

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 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
- NFPA 72 (2013) National Fire Alarm and Signaling Code
- NFPA 90A (2015) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

- UL 1242 (2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
- UL 1971 (2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired
- UL 268 (2009) Smoke Detectors for Fire Alarm Systems
- UL 268A (2008; Reprint Oct 2014) Smoke Detectors for Duct Application
- UL 38 (2008; Reprint Nov 2013) 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 2014) Electrical Rigid Metal Conduit-Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Storage Batteries
Low Battery Voltage
Spare Parts
Technical Data and Computer Software; G
Training
Testing
Smoke Detectors
Notification Appliances
Manual Stations

SD-05 Design Data

Battery Power; G

SD-06 Test Reports

Testing

SD-07 Certificates

Equipment
Qualifications

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions
Technical Data and Computer Software

1.3 OPERATING AND MAINTENANCE INSTRUCTIONS

- a. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Include complete procedures for system revision and expansion, detailing both equipment and software requirements. Provide original and backup copies of all software delivered for this project, on each type of media utilized. Obtain approval of instructions prior to

training.

- b. Submit six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide.

1.4 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 one year of service.

Furnish software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment to the Contracting Officer. Furnish two spare fuses of each type and size required, two percent of the total number of each different type of detector, but no less than two each. Spare fuses shall be mounted in the fire alarm panel.

1.5 QUALITY ASSURANCE

1.5.1 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.

1.5.2 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.

1.5.3 Installer

The installing Contractor shall provide the following: A NICET Level 3 or 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. An electrician shall be allowed to install wire or cable and to 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.

1.5.4 Fire Protection Engineer

Installations needing designs or modifications of fire detection, fire alarm, or fire suppression systems will 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:

1.5.5 Detail Drawings

Submit detail drawings prepared and signed by a Registered Professional Engineer consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. Check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

1.6 TECHNICAL DATA AND COMPUTER SOFTWARE

Deliver 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, in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Identify the data delivered 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 described under SD-19 in the SUBMITTALS paragraph.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Configure the fire detection and alarm system and the central reporting system in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards. Furnish tags with stamped identification number for keys and locks. Locks shall be keyed alike. Provide four keys for the system.

2.1.1 Operation

Modify the existing fire alarm and detection system in accordance with the drawings to be a complete, supervised fire alarm reporting system. Activate the system into the alarm mode by actuation of any alarm initiating device. Remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Connect alarm initiating devices to initiating device circuits (IDC), in accordance with NFPA 72. Connect alarm notification appliances to notification appliance circuits (NAC), in accordance with NFPA 72. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Operate fire alarm system components requiring power, except for the control panel power supply, on 24 Volts dc.

2.1.2 Operational Features

The system shall maintain the existing system the following operating features:

- a. Zones for alarm IDC and NAC shall be as follows: expand the existing circuits as necessary to install the new devices.

2.1.3 Alarm Functions

An alarm condition on a circuit shall signal as originally configured.

2.1.4 Primary Power

Provide operating power 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.

2.1.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

2.1.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. The new equipment shall be connected to an existing control panel in the existing part of the building. 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.

2.1.7 Interface With Other Equipment

Furnish interfacing components 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.

2.2 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.

2.3 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.

2.4 CONTROL PANEL

2.4.1 Circuit Connections

Connect circuit conductors entering or leaving the existing to remain panel to screw-type terminals with each conductor and terminal marked for identification.

2.5 STORAGE BATTERIES

2.5.1 Capacity

Provide storage batteries that 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. Submit substantiating battery calculations for supervisory and alarm power requirements. Include ampere-hour requirements for each system component and each panel component, and the battery recharging period.

2.5.2 Placement

Locate batteries in a separate battery cabinet. 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. Key the lock the same as the fire alarm control panel. Paint cabinets to match the fire alarm control panel.

2.6 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.

2.7 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Connect manual stations into signal line circuits. Stations shall be installed on surface mounted outlet boxes 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 not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. 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.

2.8 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Installed devices shall conform to the NFPA 70 hazard classification of the area where devices are to be installed.

2.8.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70 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.

2.8.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for semi-flush outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test

rating for the Rate-of-Rise detectors shall be rated for 50 by 50 ft.

2.8.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. 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 suitable for mounting in a finished, visible location.

2.8.2.1 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. Detectors shall have an obscuration rating in accordance with UL 268.

2.9 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 white.

2.9.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box recessed single vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet.

2.9.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

2.9.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units, except that 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.

2.10 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.10.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

2.10.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. Wiring for Fire Alarm circuits shall be No. 16 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 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.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, perform a functionality test for the entire system including propane zones 8 and 9 of the radio alarm transmitter, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.2.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.2.2 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 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.

3.2.4 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

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).

3.4 GROUNDING

Provide grounding by connecting to building ground system.

3.5 TRAINING

Provide training course for the operations and maintenance staff. Conduct the course in the building where the system is installed or as designated by the Contracting Officer. 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. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

3.5.1 System Operation Training

The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

3.6 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 30 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.

3.6.1 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.

3.6.2 Acceptance Test

Do not perform acceptance testing until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. Complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.

- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault.
- k. Short circuit faults.
- l. Stray voltage.
- m. Loop resistance.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL

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.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C33/C33M (2013) Standard Specification for Concrete Aggregates

ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2321 (2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

ASTM D2434 (1968; R 2006) Permeability of Granular Soils (Constant Head)

ASTM D2487 (2011) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D4318 (2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D6938 (2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM D698 (2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard

Effort (12,400 ft-lbf/cu. ft. (600
kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 2011) Safety and Health
Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846.3-3 (1999, Third Edition, Update III-A) Test
Methods for Evaluating Solid Waste:
Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil types, abbreviated as percent laboratory maximum density.

1.2.2 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.3 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

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

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Density tests

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7.2 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. 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.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

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

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Common Fill

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

2.1.5 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.6 Select Material

Provide materials classified as GW, GP, SW, SP, or more granular by ASTM D2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. Coefficient of permeability shall be a minimum of 0.002 feet per minute when tested in accordance with ASTM D2434.

2.1.7 Topsoil

Provide as specified in Section 32 92 19SEEDING.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

- a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.3.1 Sand

Clean, coarse-grained sand classified as Fine Aggregates in accordance with Section 1003 of the Illinois DOT Standard Specifications for Road and Bridge Construction, dated January 1, 2012 or SW or SP by ASTM D2487 for bedding and backfill

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof Coarse Aggregates in accordance with Section 1004 of the Illinois DOT Standard Specifications for Road and Bridge Construction, dated January 1, 2012 or having a classification of GW or GP in accordance with ASTM D2487 for bedding and backfill. Maximum particle size shall not exceed 3 inches.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.5 BURIED WARNING AND IDENTIFICATION TAPE

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

similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air
Purple:	Non Potable, Reclaimed Water, Irrigation and Slurry lines

2.5.1 Warning Tape for Metallic Piping

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

2.5.2 Detectable Warning Tape for Non-Metallic Piping

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

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring trench boxes and sheeting where required. In addition to Section 25 A and B of EM 385-1-1 and other requirements set forth in this contract, include provisions in the shoring and sheeting plan that will accomplish the following:

- a. Prevent undermining of pavements, foundations and slabs.
- b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/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/or provide temporary ditches, dikes, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. 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. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the limits of disturbance. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with backfill and fill material and compact to 95 percent of ASTM D1557 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.2 Hard Material and Rock Excavation

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.4 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.5 FILLING AND BACKFILLING

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

3.5.1 Common Fill Placement

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

3.5.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.5.3 Select Material Placement

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

3.5.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.5.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.5.6 Trench Backfilling

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

3.6 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.7 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.

3.8 COMPACTION

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

3.8.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 90 percent of ASTM D1557.

3.8.2 Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill material to 95 percent of ASTM D1557.

3.8.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D1557.

3.8.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill materials to 95 percent of ASTM D1557.

3.9 FINISH OPERATIONS

3.9.1 Grading

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

3.9.2 Topsoil and Seed

Provide as specified in Section 32 92 19 SEEDING.

3.9.3 Protection of Surfaces

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

3.10 DISPOSITION OF SURPLUS MATERIAL

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

3.11 FIELD QUALITY CONTROL

3.11.1 Sampling

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

3.11.2 Testing

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

3.11.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.11.2.2 Select Material Testing

Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.11.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M.

3.11.2.4 Density Tests

Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every 100 square feet of existing grade in fills for structures and concrete slabs, and every 200 square feet for other fill areas and every 200 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 50 linear feet in each lift.

-- End of Section --

SECTION 32 01 19

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS
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.

ASTM INTERNATIONAL (ASTM)

ASTM C1016	(2014) Standard Test Method for Determination of Water Absorption of Sealant Backing (Joint Filler) Material
ASTM D5893/D5893M	(2010) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6690	(2012) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D789	(2007; E 2010) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 525	(1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

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

Manufacturer's Recommendations; G, AE.
Equipment.

SD-04 Samples

Materials; G, AE.

SD-06 Test Reports

Certified copies of the test reports; G.

1.3 QUALITY ASSURANCE

1.3.1 Test Requirements

Test the joint sealant and backup or separating material for conformance with the referenced applicable material specification. Perform testing of the materials in an approved independent laboratory and submit certified copies of the test reports for approval 30 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials. Submit samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 15 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

1.3.2 Trial Joint Sealant Installation

Prior to the cleaning and sealing of the joints for the entire project, prepare a test section at least 200 feet long using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, inspect the test section to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, remove the materials, and reclean and reseal the joints at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. Prepare and seal all other joints in the manner approved for sealing the test section.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the job site for defects, unload, and store them with a minimum of handling to avoid damage. Provide storage facilities at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Do not apply sealant if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

	Sealing Material
	ASTM D6690, Type II and COE CRD-C 525
	ASTM D6690, Type III and COE CRD-C 525

2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, use them in accordance with the recommendation of the manufacturer.

2.3 BACKUP MATERIALS

Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C1016. Use backup material that is 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

Provide a bond breaking tape or separating material that is a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 EXECUTING EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started maintained in satisfactory condition at all times.

3.1.1 Joint Cleaning Equipment

3.1.1.1 Concrete Saw

Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

3.1.1.2 Sandblasting Equipment

Include with the sandblasting equipment an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and capable of furnishing not less than 150 cfm and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Demonstrate compressor capability, under job conditions, before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to secure satisfactory results.

3.1.1.3 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

3.1.2 Sealing Equipment

3.1.2.1 Two-Component, Cold-Applied, Hand-Mix Sealing Equipment

Mixing equipment for FS SS-S-200 Type H sealants shall consist of a slow-speed electric drill or air-driven mixer with a stirrer in accordance with the manufacturer's recommendations. Submit printed copies of manufacturer's recommendations, 30 days prior to use on the project, where installation procedures, or any part thereof, are required to be in accordance with those recommendations. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

3.1.2.2 Cold-Applied, Single-Component Sealing Equipment

The equipment for installing ASTM D5893/D5893M single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

3.2 PREPARATION OF JOINTS

Immediately before the installation of the sealant, thoroughly clean the joints to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

3.2.1 Existing Sealant Removal

Cut loose the in-place sealant from both joint faces and to the depth shown on the drawings, using the concrete saw as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any separating or backup material that is required to maintain the depth of new sealant to be

installed. Prior to further cleaning operations, remove all loose old sealant remaining in the joint opening by blowing with compressed air. Hand tools may be required to remove sealant from random cracks. Chipping, spalling, or otherwise damaging the concrete will not be allowed.

3.2.2 Sawing

3.2.2.1 Refacing of Joints

Accomplish refacing of joints using a concrete saw as specified in paragraph EQUIPMENT to saw through sawed and filler-type joints to loosen and remove material until the joint is clean and open to the full specified width and depth. Stiffen the blade with a sufficient number of suitable dummy (used) blades or washers. Thoroughly clean, immediately following the sawing operation, the joint opening using a water jet to remove all saw cuttings and debris.

3.2.2.2 Refacing of Random Cracks

Accomplish sawing of the cracks using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 6 inches or less in diameter to enable the saw to follow the trace of the crack. Stiffen the blade, as necessary, with suitable dummy (or used) blades or washers. Immediately following the sawing operation, thoroughly clean the crack opening using a water jet to remove all saw cuttings and debris.

3.2.3 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be sandblasted clean. Use a multiple-pass technique until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water.

3.2.4 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a back-up material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.2.5 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond breaker separating tape to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

3.2.6 Rate of Progress of Joint Preparation

Limit the stages of joint preparation, which include sandblasting, air pressure cleaning and placing of the back-up material to only that lineal footage that can be sealed during the same day.

3.3 PREPARATION OF SEALANT

3.3.1 Single-Component, Cold-Applied Sealants

Inspect the ASTM D5893/D5893M sealant and containers prior to use. Reject any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.4 INSTALLATION OF SEALANT

3.4.1 Time of Application

Seal joints immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints, that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.4.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/8 inch plus or minus 1/16 inch below the pavement surface. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.5 INSPECTION

3.5.1 Joint Cleaning

Inspect joints during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints will be approved prior to installation of the separating or back-up material and joint sealant.

3.5.2 Joint Sealant Application Equipment

Inspect the application equipment to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set will be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.5.3 Joint Sealant

Inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from

the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.6 CLEAN-UP

Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

-- End of Section --

SECTION 32 11 16.16

BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING

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.

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D6270	(2008; R 2012) Use of Scrap Tires in Civil Engineering Applications
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System
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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

Materials; (LEED NC); G, AE
Geotextile; (LEED NC); G, AE

SD-05 Design Data

Gradation curve; G, AE

SD-06 Test Reports

Bearing ratio; G, AE

Liquid limit; G, AE

Plasticity index; G, AE

Dry weight of slag; G, AE

Percentage of wear; G, AE

Gradation tests; G, AE

Density tests; G, AE

SD-07 Certificates

Source; G, AE

Location and name.

1.3 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not construct course when atmospheric temperature is below 35 degrees F or when weather conditions could detrimentally affect quality of finished course. When temperature falls below 35 degrees F, protect areas of completed course against freezing.

PART 2 PRODUCTS

2.1 MATERIALS

Subbase course for flexible pavement and base course for rigid concrete pavement shall be by IDOT (Illinois Department of Transportation) Type A Aggregate Base Course consisting of durable and sound crushed gravel, crushed stone, or crushed slag. IDOT Type A Aggregate Base Course shall be in accordance with Section 351 of the IDOT Standard Specifications for Road and Bridge Construction, dated January 1, 2012.

2.2 SOURCE QUALITY CONTROL

Prior to production and delivery of aggregates, take at least one initial

sample in accordance with ASTM D75/D75M. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 50 pounds. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

PART 3 EXECUTION

3.1 GRADE CONTROL

Provide line and grade stakes for control. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.

3.2 PLACING AND MIXING

Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course. Verify subsoils have a permeability between 0.5 and 3.0 inches per hour. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. Place geotextiles in accordance with specifications and drawings. Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 3 and 8 inches in compacted thickness. Tire shall be installed in accordance with ASTM D6270.

3.3 COMPACTING AND FINISHING

Compact each layer to at least 100 percent of the maximum laboratory density determined in accordance with ASTM D1557 for areas subject to heavy vehicular traffic. Compact each layer to at least 95 percent Standard Proctor Density per ASTM D698 for pedestrian areas. Compact material inaccessible to rolling equipment by mechanical tamping. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density. Place and compact earth at edges of course for at least one foot of the shoulder.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling During Construction

Take one random sample of each 50 tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D75/D75M.

3.4.2 Testing

3.4.2.1 Material

Make gradation tests from each sample in accordance with ASTM C136. Determine material passing the No. 200 sieve in accordance with ASTM C117.

3.4.2.2 Smoothness Test

Test with a 10 foot straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of

3/8 inch by loosening, adding or removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.

3.4.2.3 Field Density Tests

ASTM D1556 or ASTM D6938. Take one field density test for each 100 square yards of each layer of course. When using ASTM D6938 to test field compaction densities, verify the results of the tests by performing one test per day using ASTM D1556 at locations previously tested by ASTM D6938 and one additional test using ASTM D1556 for every ten tests performed at locations previously tested by ASTM D6938.

3.4.2.4 Laboratory Density Tests

ASTM D1557, Method B, C, or D, for all material.

3.4.2.5 Thickness Test

Determine thickness of course from test holes not less than 3 inches in diameter. Obtain a thickness test for each 100 square yards of course. Where course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than 1/2 inch, consider the measured thickness as the indicated or specified thickness plus 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than 1/4 inch.

3.5 MAINTENANCE

After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --

SECTION 32 12 17.05

BITUMINOUS PAVING

PART 1 GENERAL

1.1 APPLICABLE PUBLICATION

Illinois Department of Transportation Standard Specifications for Road and Bridge Construction dated January 1, 2012, referred to herein as the Illinois Specification.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Job-Mix Formula; G, AE

Copies of Job mix formula test results and reports 30 days prior to use on the project.

SD-06 Test Reports

Density Testing; G, AE

SD-07 Certificates

Tack Coat Materials; G, AE

1.3 DEFINITIONS

Reference to "Engineer" shall be interpreted to mean "Contracting Officer."

1.4 TESTING

All testing shall be done by an independent commercial testing laboratory at the Contractor's expense and responsibility.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not place the hot-mix asphalt on a wet surface or when the surface temperature of the underlying course is less than specified in Table 3. The temperature requirements may be waived by the Contracting Officer if requested. However all other requirements, including compaction, shall be met.

Table 3: Surface Temperature Limitations of Underlying Course

Mat Thickness (inches)	Degrees (F)
3 or greater	40
Less than 3	45

PART 2 MATERIALS

2.1 BITUMINOUS COURSE(S)

Bituminous Course(s) shall conform to the requirements of Section 406 Hot-Mix Asphalt Binder and Surface Course and Section 1030 Hot-Mix Asphalt of the Illinois Specification, except as modified herein.

2.2 MATERIALS

Section 1030.01 Description; Section 1030.02, Materials; Section 1030.04 Asphalt Concrete Mixtures. Type Mix Types IL-9.5L Surface and IL-19.0 L Binder bituminous concrete shall be used.

2.3 JOB MIX FORMULA

Section 1030.04(a), Job-Mix Formula. The job mix formula shall be an Illinois Department of Transportation Approved Mix. All information required by section 1030.04 shall also be submitted to the Contracting Officer for approval.

2.4 TESTS AND PLANT INSPECTION

Testing and plant inspection shall be performed by an independent recognized commercial testing laboratory at the Contractor's expense and responsibility in accordance with Section 1030.05 Quality Control/Quality Assurance (QA/QC) of the Illinois Specification..

2.5 TACK COAT

Tack coat materials shall be asphalt emulsion (CSS-1h) conforming to Section 1032.06.

2.6 AGGREGATE BASE COURSE

Aggregate base courses shall conform to the requirements of Section 32 11 16.16 BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING.

PART 3 EXECUTION

3.1 EARTHWORK AND SUBGRADE PREPARATION

Earthwork and Subgrade Preparation shall conform to Section 32 11 16.16 BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING, Section 31 23 00.00 20 EXCAVATION AND FILL, and Section 301 of the Illinois Specifications.

3.2 AGGREGATE BASE COURSE

Aggregate base course shall conform to the requirements indicated in PART 2 of this specification.

3.3 TACK COAT

Refer to Section 406.05, Preparation, Priming and Leveling of Brick, Concrete, NMA or Aggregate Bases. A tack coat shall be applied to all areas indicated on the drawings or directed by the Contracting Officer. Materials shall be as indicated in PART 2 of this specification. Surfaces to receive a tack coat shall be free of excess dust and other loose material. Application rates shall range from 0.05 to 0.25 gallon per square yard. The actual application rate shall be determined by the Contracting Officer from the results of a trial strip. Work shall be planned so that no more tack coat than is necessary for the day's operation is placed on the surface. The tack coat shall be permitted to cure until the proper degree of tackiness, as determined by the Contracting Officer, has been obtained. Sand shall be used to blot up excess bituminous material when directed by the Contracting Officer.

3.4 TRANSPORTING AND PLACING

3.4.1 Transporting

Transport the hot-mix asphalt from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, use a material transfer vehicle operated to produce continuous forward motion of the paver.

3.4.2 Placing

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.5 COMPACTION

Section 406.07, Compaction.

3.5.1 Density Testing

The determination of the pavement density shall be performed by an independent recognized commercial testing laboratory at the Contractor's expense and responsibility. Although the nuclear field density testing

method may be used for operational control during pavement placement, the final acceptance of pavement will be based on the test results from the cored pavement samples.

3.5.2 Samples

Samples for determining pavement densities shall be taken with a coring machine or by cutting a 6-inch square out of the pavement. One set (three samples) shall be taken for every 100 tons of material placed. Density samples of the day's production should be taken and tested by noon of the following day and the results submitted to the Contracting Officer within 24 hours after completion of the testing. The bituminous course shall be compacted to not less than 95% of design density. The design density is defined as the compacted unit weight of the mixture, at the job-mix asphalt content and design voids, as established by the superpave design gyrations for the mixture.

3.6 JOINTS

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

3.6.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. Remove the cutback material from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.6.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.7 GRADE

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement

surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, test the final wearing surface of the pavement for conformance with the specified plan grade. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.8 SURFACE SMOOTHNESS

Use the following method to test and evaluate surface smoothness of the pavement. Perform all testing in the presence of the Contracting Officer. Keep detailed notes of the results of the testing and furnish a copy to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.8.1 Smoothness Requirements

Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances of 1/4 inch in both the longitudinal and transverse directions, when tested with an approved 12 feet straightedge.

3.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Test each lot of the pavement in both a longitudinal and a transverse direction on parallel lines. Set the transverse lines 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 20 feet wide and at the third points for lanes 20 feet or wider. Also test other areas having obvious deviations. Longitudinal testing lines shall be continuous across all joints.

- a. Straightedge Testing. Hold the straightedge in contact with the surface and move it ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

-- End of Section --

SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M (2014) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C143/C143M (2012) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C171 (2007) Standard Specification for Sheet Materials for Curing Concrete

ASTM C172/C172M (2014a) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C173/C173M (2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C231/C231M (2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

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 C920 (2014a) Standard Specification for Elastomeric Joint Sealants

ASTM D1751 (2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and

Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D1752 (2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

ASTM D5893/D5893M (2010) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.2.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

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-03 Product Data

Concrete; G, AE

SD-06 Test Reports

Field Quality Control; G, AE

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The

underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

Wire mesh reinforcement shall conform to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D1751 or ASTM D1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 31 23 00.00 20 EXCAVATION AND FILL.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope to match existing slope of adjacent walkways. Side forms shall not be removed for 12 hours after finishing has been completed.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated by tamping and spading or with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.2 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURING AND PROTECTION

3.6.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.6.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.6.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.6.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and

in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.6.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.6.3 Protection

Completed concrete shall be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.6.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.6.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean

before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.6.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.7 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.7.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.7.2 Concrete Testing

3.7.2.1 Strength Testing

Provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C172/C172M. Cylinders for acceptance shall be molded in conformance with ASTM C31/C31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.7.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. ASTM C231/C231M shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.7.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.7.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.7.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.8 SURFACE DEFICIENCIES AND CORRECTIONS

3.8.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.8.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.8.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 32 92 19

SEEDING
10/06

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.

ASTM INTERNATIONAL (ASTM)

ASTM D4972 (2013) pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

DOA SSIR 42 (1996) Soil Survey Investigation Report
No. 42, Soil Survey Laboratory Methods
Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 23 00.00 20 EXCAVATION AND FILL applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

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

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

SD-07 Certificates

State certification and approval for seed

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Planting Dates

<u>Planting Season</u>	<u>Planting Dates</u>
Season 1	Aug. 15 - Sept. 7
Season 2	April 1 - May 1

2.1.3 Seed Purity

Botanical Name	Common Name	Minimum Percent Pure Seed	Minimum Percent Germination and Hard Seed	Maximum Percent Weed Seed
Poa pratensis *1	Kentucky Bluegrass	90	80	0.5%
Festuca spp *2	Fine Fescue	95	80	0.5%
Lolium perenne *3	Perennial Ryegrass	95	80	0.5%

*1 Choose a minimum of 3 Cultivars from the following list: 4-Season, Arrowhead, Avid, Beyond, Blue Note, Bluestone, Diva, Granite, Impact, Midnight, NuChicago, Rhythm, Sudden Impact, Zinfandel

*2 Fine Fescue shall be combined with Kentucky Bluegrass, min. 2 cultivars from the following list: Ambassador, Bighorn, Cascade, Epic, Intrigue, Intrigue 2, Jasper II, Nordic, Osprey, Salsa Superior, Shademaster III, Spp.

*3 Perennial Ryegrass may be combined with Kentucky Bluegrass. Choose a minimum of 2 cultivars from the following list: Allstar 3, Amazing CS, Apple GL, Attribute, Chivalry, Fiesta 4, Fiji, Homerun, Keystone 2, Palmer IV or V, Primary, Silver Dollar, Top Gun II, Uno.

2.1.4 Seed Mixture by Weight

	<u>Variety</u>	<u>Percent (by Weight)</u>
Mix No. 1	Kentucky Bluegrass	40 - 60%
	Fine Fescue	30% - 40%
	Perennial Ryegrass	10% - 20%

	<u>Variety</u>	<u>Percent (by Weight)</u>
Mix No. 2	Kentucky Bluegrass	80% - 90%
	Perennial Ryegrass	10% - 20%

Proportion seed mixtures by weight.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent
Clay	10-30 percent
Sand	20-35 percent
pH	5.5 to 7.0 percent
Soluble Salts	550 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following

minimum percentages, by weight, of plant food nutrients:

- 3 percent available nitrogen
- 1 percent available phosphorus
- 2 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer pH adjusters into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 3 pounds per 1000 square feet.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method shall be broadcasted and drop seeding.

3.2.2.1 Broadcast and Drop Seeding

Seed shall be uniformly broadcast at the rate of 3-4 pounds per 1000 square feet. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and moist and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after planting, protect area against traffic and other use.

-- End of Section --

SECTION 33 11 23

NATURAL GAS AND LIQUID PETROLEUM GAS PIPING
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 NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z21.45 (1995) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
- ANSI Z21.69/CSA 6.16 (2009; Addenda A 2012; R 2014) Connectors for Movable Gas Appliances

ASME INTERNATIONAL (ASME)

- ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)
- ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)
- ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded
- ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300
- ASME B16.33 (2012) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, Sizes NPS 1/2 - NPS 2
- ASME B16.38 (2012) Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 1/2 to 12, 125 psig Maximum)
- ASME B16.39 (2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
- ASME B16.40 (2013) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
- ASME B16.5 (2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
- ASME B16.9 (2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings
- 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 B31.8 (2013) Gas Transmission and Distribution
Piping Systems

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for
Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M (2014) Standard Specification for Seamless
Carbon Steel Pipe for High-Temperature
Service

ASTM A193/A193M (2014) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A194/A194M (2014) Standard Specification for Carbon
and Alloy Steel Nuts for Bolts for
High-Pressure or High-Temperature Service,
or Both

ASTM A53/A53M (2012) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

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

MSS SP-69 (2003; Notice 2012) Pipe Hangers and
Supports - Selection and Application (ANSI
Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2015) National Fuel Gas Code

NFPA 58 (2014; TIA 13-1; TIA 13-2; Errata 13-1;
TIA 13-3; Errata 14-2) Liquefied Petroleum
Gas Code

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2
2013; Errata 2 2013; AMD 3 2014; Errata
3-4 2014; AMD 4-6 2014) National
Electrical Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA 1981 (2008) Seismic Restraint Manual Guidelines

for Mechanical Systems, 3rd Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines &
for Compressed Gas Cylinders

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

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

49 CFR 195 Transportation of Hazardous Liquids by
Pipeline

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pressure regulator; G
Gas equipment connectors; G
Valves; G
Warning and identification tape; G
Risers; G
Transition fittings; G
Pneumatic emergency shutoff valves; G
Liquid transfer pump; G
Vertical waterbath vaporizers; G
Propane sensors; G
Carbon Dioxide Cylinder Manifolding System

SD-07 Certificates

Welder's qualifications; G
PE welder's qualifications; G
Welder's identification symbols; G
Documentation of training for all key personnel

SD-08 Manufacturer's Instructions

Pipe and fittings; G

Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Contractor

Propane contractor must have a minimum of 5 years' experience in installing propane systems of the size and complexity of this project.

1. Key personnel involved with the upgrading of the propane container system, vaporizer system and all associated piping and equipment shall have successfully completed the following portions of the Propane Education & Training (PERC), Certified Employee Training Program (CETP):
 - a. Basic Principles and Practices (Book 1)
 - b. Basic Plant Operations (Book 3.0)
 - c. Designing and Installing Exterior Vapor Systems (Book 4.1)
 - d. Placing Vapor Distribution Systems into Operations (Book 4.2)
 - e. Installing Appliances and Interior Vapor Distribution Systems (Book 4.3)
2. In addition to the above, key personnel shall be trained and/or Qualified in accordance with the following:
 - a. NFPA 58, 2014 Edition Sec. 4.4
 - b. NFPA 54, 2015 Edition Sec. 3.3.81 & 4.1
 - c. Installing specific equipment shall be trained by the equipment manufacturer.
 - d. In accordance with 29 cfr 1010-110 for work with propane.
 - e. In accordance with 29 cfr 1926 for construction.
3. Qualified means trained, tested through written testing, and skill assessments where necessary.
4. All training or refresher training shall have been successfully completed within the previous three (3) years.
5. All training shall be documented.
6. Documentation of training for all key personnel shall be submitted for review.

1.4.2 Qualification of Installer

Propane contractor's installer must be approved, authorized, or licensed by the insert industry standard and have a minimum of five years' experience as an approved, authorized, or licensed propane contractor and be approved at a level capable of providing the specified scope. The installer must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Qualification of Inspector

Contractor shall hire full-time third-party Propane Inspectors for the life of this Contract who will be on site daily during propane operations to perform Inspection Duties required for proper installation of propane equipment and piping. Inspectors shall supply names, locations, and client contract information of 5 projects of similar size and scope that the Inspectors have witnessed with a scope similar to that specified. Qualifications for Inspectors shall include one of the following:

1. Propane Inspector must be approved, authorized or licensed in writing by insert industry standard. Inspector shall have a minimum 10 years' experience.
2. Propane Inspector must be licensed professional engineer demonstrating 10 years' continuous specialized experience in design, investigation, testing, and consulting services related to propane systems of the size and type specified.

Inspectors shall have a thorough knowledge of propane systems, code requirements, and safety standards associated with propane systems. Propane inspection shall be a full-time occupation Propane Inspector. Where testing is required, Propane Inspector shall be appropriately trained, certified, and licensed in the testing procedure specified.

1.4.4 Welder's Qualifications

Comply with ASME B31.8. The steel welder shall have a copy of a certified ASME B31.8 qualification test report. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1.4.5 PE Welder's Qualifications

Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the Contracting Officer that personnel are currently working in the installation of PE gas distribution lines.

1.4.6 Safety Standards

49 CFR 192 and 49 CFR 195. Refer to Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS for additional safety requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Conform to NFPA 54 and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof.

2.2 PIPE AND FITTINGS

2.2.1 Aboveground and Within Buildings and Vaults

- a. Pipe: Black steel in accordance with ASTM A53/A53M, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.
- b. Threaded Fittings: ASME B16.3, black malleable iron.
- c. Socket-Welding Fittings: ASME B16.11, forged steel.
- d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.
- e. Unions: ASME B16.39, black malleable iron.
- f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

2.2.2 Risers

Manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide wall-mounted riser supports.

2.2.3 Transition Fittings

- a. Steel to Plastic (PE): As specified for "riser" except designed for steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.
- b. Plastic to Plastic: Manufacturer's standard slip-on PE mechanical coupling, molded, with stainless-steel ring support, O-ring seals, and rated for 150 psig gas service.

2.3 SHUTOFF VALVES, BELOW GROUND

2.3.1 Metallic Ball Valves

ASME B16.33 or ASME B16.38 corrosion-resisting steel, with threaded or flanged ends. Provide polytetrafluoroethylene (PTFE) seats.

2.3.2 PE Ball or Plug Valves

ASME B16.40 Class C materials (PE 2306 or PE 3406), strength rating of Class 4 location with class factor of 0.20, and SDR matching PE pipe dimensions and working pressure.

2.4 VALVES, ABOVEGROUND

Provide lockable valves where indicated.

2.4.1 Shutoff Valves, Sizes Larger Than 2 Inches

Steel body ball valve with flanged ends in accordance with ASME B16.38.
Provide PTFE seats.

Cast-iron body plug valve in accordance with ASME B16.38, nonlubricated,
wedge-mechanism or tapered lift plug, and flanged ends.

2.4.2 Shutoff Valves, Sizes 2 Inches and Smaller

Steel body ball valve in accordance with ASME B16.33, full port pattern,
reinforced PTFE seals, threaded ends, and PTFE seat.

2.5 GAS EQUIPMENT CONNECTORS

- a. Flexible Connectors: ANSI Z21.45.
- b. Semi-Rigid Tubing and Fittings: ANSI Z21.69/CSA 6.16.

2.6 CASING

Where indicated at railroad or other crossing, provide ASTM A53/A53M,
galvanized pipe, Schedule 40, with extruded polyethylene coating.

2.7 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum-foil plastic-backed tape or detectable magnetic
plastic tape manufactured specifically for warning and identification of
buried piping. Tape shall be detectable by an electronic detection
instrument. Provide tape in rolls, 3 inch minimum width, color-coded
yellow for natural gas, with warning and identification imprinted in bold
black letters continuously and repeatedly over entire tape length. Warning
and identification shall be "CAUTION BURIED GAS PIPING BELOW" or similar
wording. Use permanent code and letter coloring unaffected by moisture and
other substances contained in trench backfill material.

2.8 HANGERS AND SUPPORTS

MSS SP-58, as required by MSS SP-69.

2.9 WELDING FILLER METAL

ASME B31.8.

2.10 PIPE-THREAD TAPE

Antiseize and sealant tape of polytetrafluoroethylene (PTFE).

2.11 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for
bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of
bolts, studs, and nuts shall conform with ASME B18.2.1 and ASME B18.2.2 with
coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and
studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through

the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.12 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.13 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

2.14 PNEUMATIC EMERGENCY SHUTOFF VALVES

Provide an additional remote emergency shutoff system.

Emergency Shutoff Control Switch cover assembly, hazardous location, unsealed, single pushbutton, red push-pull mushroom operator with 1 N.O. and 1 N.C. contact, (3) two-sided legend plates included: START/STOP, EMERGENCY STOP/RESET and blank/RESET. Requires SWB series splice/device box.

All controls and wiring shall meet Division 1, Group D requirements of NFPA 58, Liquefied Petroleum Gas Code and NFPA 70, National Electrical Code.

- (a) Automatic shutoff through thermal (fire) actuation. When fusible elements are used they shall have a melting point not exceeding 250 degrees F (121° C).
- (b) Manual shutoff from a remote location.
- (c) Manual shutoff at the installed location.

System will use a CO2 pneumatic system where the tubing itself acts as a fusible element releasing the pressure holding the valve open.

The signal from emergency shut-off valves opens a normally closed master solenoid valve located on the CO2 system releasing pressure in the system that is holding the valves open and allows valves to close.

2.15 LIQUID TRANSFER PUMP

Pump - Ductile iron, sliding vane pump with single-ended keyed shaft, mechanical seals, integral relief valve, external ball bearings, and flanged pipe connections. Underwriters Laboratory (UL) Listed for LP Gas and Anhydrous Ammonia.

- 4 Vanes - Duravane®
- 1R SE Keyed Rot/Shaft, RH Rot
- QA SNCN Seal (NH3 or LPG)
- 1 Standard Relief Valve
- B 150 PSI STE RV Spring

1 Buna Elastomers
N 2 inch NPT Flanges

MOUNTED PUMP

MNT20LGL/VB/R0343/M184T/MTRB (Template MNT20) 1

Baseplate, V-belts, Sheaves, Hubs & Guard
R0343 3.43:1 Ratio 1750/510 rpm - 1450/425 rpm
M184T For Motor Frames 184T
5HP/18R60HZ/3/184T/XP929223 (Template MOTOR) 1
5 HP, 1800 rpm, 60 Hz, Explosion Proof, 3 Ph 230/460 Volt, 184T Motor
BV1.5A/2/1/0/0 (Template BV150) 1
1.5 inch Bypass Valve, Ductile Iron, with Pressure Equalization
2 Steel 41-70 psi
1 Buna Elastomers
0 1.5 inch NPT Inlet Port
0 1.5 inch NPT Outlet Port
UL Listed for LPG
*** SET AT 50 PSI DIFFERENTIAL ***

2.16 VERTICAL WATERBATH VAPORIZERS

The unit shall be a gas-fired Waterbath LP-Gas vaporizer package completely fabricated, piped, painted, and ready to be placed on the existing foundation (if vaporizers are larger than existing foundation, remove and replace with new concrete foundation of sufficient size) to receive the contractor's interconnecting piping and wiring.

The unit is to be complete with all necessary controls and valve trains to receive liquid propane from a liquid supply line and provide LP-Gas vapor to the load, and shall have a maximum output capacity of no less than 73 Million BTU's/Hr. The rated capacity of the vaporizer is defined at 0 degrees F inlet temperature and 100 PSIG propane pressure.

The vaporizer shall consist of a vertical vessel to hold a water and ethylene/glycol mixture appropriate for freeze protection for the lowest expected ambient temperatures. The liquid in the vessel shall be heated by a forced draft powered burner firing into fire tubes permanently fabricated into the vessel. The fire tubes shall be single pass fire tubes with a riser protruding through the top of the shell emitting the products of combustion through the discharge flue. Burner equipment and fire tube design shall be such that an external stack is not required. The vessel shall be vented to the atmosphere and shall contain an external expansion tank of sufficient capacity to allow for expansion of the liquid from the normal water line when heated from 40 degrees F to 200 degrees F.

The burner assembly shall be enclosed and properly vented in an integral housing. The combustion equipment shall consist of a forced draft power burner containing its own combustion air fan, automatic ignition, electronic flame safeguard, and controls to provide for pre-purge. The burner shall be controlled by an Aquastat bulb type temperature switch and a high temperature limit switch.

The unit shall be equipped with a solid state digital display "First Out Annunciator" to instantly indicate the cause of any safety shutdown. The annunciated safeties must include:

1. Power failure

2. Flame failure
3. Waterbath over-temperature
4. Waterbath low liquid level
5. LPG high liquid level
6. LPG high pressure

The LP-Gas vaporizing single pass heat exchanger core shall be designed and built to ASME codes including an internal vapor outlet header to minimize heat loss. Velocities in the tubes shall be low enough to prevent liquid carry-over during normal operation.

The unit shall be equipped with a float switch to prevent liquid LP from being passed through the vapor outlet and shall be equipped with a pressure relief valve to prevent unsafe pressure in the heat exchanger tubes. This relief valve shall be sized in accordance with NFPS Pamphlet #58.

Waterbath shall include a circulation pump to eliminate thermal stratification and increase water side heat transfer.

The shell of the liquid bath vessel shall be insulated with closed cell foam. Insulation must maintain R-value when exposed to moisture.

Weatherproof enclosure shall be galvanized and powder coated to ensure maximum rust protection.

The contractor shall install the vaporizer on the existing concrete foundation.

The contractor shall furnish and install necessary interconnecting electrical wiring in accordance with the manufacturer's details.

The contractor will also provide 296 gallons of de-ionized water and rust inhibited glycol for the water bath solution.

2.17 PROPANE SENSORS

Sensors designed to detect when a propane concentration in air of 1/5 of the Lower Explosive Limit (LOL) of gas-in-air has been reached and to provide output for inter-connection with a host microcontroller to alarm of the presence of propane.

Power Requirements: 5 VDC @ ~160mA

Interface Type: Resistive

Operating Temperature Range: -14 to +122 degrees F (-10 to +50 °C)

2.18 3-WAY QUICK EXHAUST SOLENOID VALVE

Explosion proof and watertight enclosure , CSA Certified and UL listed, 1/4 inch normally closed Quick Exhaust Solenoid Valve with brass or stainless steel body, NBR seals and disc, 305 stainless steel core tube, and 430f stainless steel core and plugnut designed for quick venting to 0 psi through the exhaust orifice. 120 volts, 60hz.

2.19 CARBON DIOXIDE CYLINDER MANIFOLDING SYSTEM

2.19.1 Piping

Materials for piping and the standards covering these materials shall be as described as follows:

1. Black or galvanized steel pipe shall be either ASTM A53/A53M seamless or electric welded, Grade A or B; or ASTM A106/A106M, Grade A, B, or C.
 - a. ASTM A120 and ordinary cast-iron pipe shall not be used.
 - b. Stainless steel shall be TP304 or TP316 for threaded connections or TP304, TP316, TP304L, or TP316L for welded connections.
2. In systems using high-pressure supply, 3/4 inch (20 mm) and smaller pipe shall be permitted to be Schedule 40.
 - a. Pipe that is 1 inch (25 mm) through 4 inch (100 mm) shall be a minimum of Schedule 80.
 - b. Furnace butt-weld ASTM A53/A53M pipe shall not be used.
3. In systems using low-pressure supply, pipe shall be a minimum of Schedule 40.
 - a. Furnace butt-weld ASTM A53/A53M pipe shall be permitted to be used.
4. A dirt trap consisting of a tee with a capped nipple, at least 2 inches (51 mm) long, shall be installed at the end of each pipe run.
5. Piping sections not normally opened to atmosphere shall not be required to have corrosion-resistant finish on the inside.
6. Flexible piping system components not specifically covered in this standard shall have a minimum burst pressure of 5000 psi (34,474 kPa) for high-pressure systems or 1800 psi (12,411 kPa) for low-pressure systems.
7. Class 150 and cast-iron fittings shall not be used.
8. Fittings for high- and low-pressure systems shall be as described in 4.7.1.5.1 and 4.7.1.5.2.
9. Pipe shall be reamed and cleaned before assembly, and after assembly the entire piping system shall be blown out before nozzles or discharge devices are installed.

2.19.2 Pressure Relief Devices

In systems where valve arrangement introduces sections of closed piping, such sections shall be equipped with pressure relief devices, or the valves shall be designed to prevent entrapment of liquid carbon dioxide.

1. For high-pressure systems, the pressure relief devices shall operate at a pressure no less than 2400 psi (16,547 kPa) and no more than 3000 psi (20,684 kPa).
2. For low-pressure systems, the pressure relief devices shall operate at a pressure no higher than 450 psi (3103 kPa).

All pressure relief devices shall be of such design and so located that the discharge of carbon dioxide therefrom will not injure personnel.

2.19.3 Manifold Valves

All valves shall be suitable for the intended use, particularly regarding flow capacity and operation.

All valves shall be used only under temperatures and other conditions for which they are listed or approved.

Valves used in systems with high-pressure storage and constantly under pressure shall have a minimum bursting pressure of 6000 psi (41,369 kPa), whereas those not under constant pressure shall have a minimum bursting pressure of at least 5000 psi (34,474 kPa).

Valves used in systems using low-pressure storage shall withstand a hydrostatic test to 1800 psi (12,411 kPa) without permanent distortion.

For flanged valves, the class and style of flanges required to match the valve's flanged connection shall be used.

Valves shall be located, installed, or suitably protected so that they are not subject to mechanical, chemical, or other damage that would render them inoperative.

Valves shall be rated for equivalent length in terms of the pipe or tubing sizes with which they will be used.

The equivalent length of cylinder valves shall include siphon tube, valve, discharge head, and flexible connector.

2.19.4 Cylinders

Cylinders that meet the following TC/DOT specifications are authorized for liquefied carbon dioxide service:

1. 3A1800
2. 3HT2000
3. 3AA1800
4. 3E1800
5. 3T1800
6. 3AX1800
7. AL1800
8. 3AL1800

2.19.5 Cylinder Valves

Cylinders shall be equipped to discharge gas (vapor).

The standard valve outlet connection in the United States for carbon dioxide is Connection CGA 320.

Pressure relief devices authorized for use on carbon dioxide cylinders include the Type CG-1 rupture disk and the Type CG-7 pressure relief valve.

PART 3 EXECUTION

3.1 INSTALLATION

Install gas piping, appliances, and equipment in accordance with NFPA 54. Install distribution piping in accordance with ASME B31.8. Install and

store liquefied petroleum gas piping, appliances, and equipment in accordance with NFPA 58.

3.1.1.1 Excavating and Backfilling

Perform excavating and backfilling of pipe trenches as specified in Section 31 23 00.00 20 EXCAVATION AND FILL. Place pipe directly in trench bottom and cover with minimum 3 inches of sand to top of pipe. If trench bottom is rocky, place pipe on a 3 inch bed of sand and cover as above. Provide remaining backfilling. Coordinate provision of utility warning and identification tape with backfill operation. Bury utility warning and identification tape with printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.2 Piping

Cut pipe to actual dimensions and assemble to prevent residual stress. Provide supply connections entering the buildings as indicated. Within buildings, run piping parallel to structure lines. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap. To supply multiple items of gas-burning equipment, provide manifold with inlet connections at both ends.

3.1.2.1 Cleanliness

Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear. Cap or plug pipe ends to maintain cleanliness throughout installation.

3.1.2.2 Aboveground Steel Piping

Determine and establish measurements for piping at the job site and accurately cut pipe lengths accordingly. For 2 inch diameter and smaller, use threaded or socket-welded joints. For 2 1/2 inch diameter and larger, use flanged or butt-welded joints.

- a. Threaded Joints: Where possible use pipe with factory-cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ASME B1.20.1. Provide threads smooth, clean, and full-cut. Apply anti-seize paste or tape to male threads portion. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to valves for which a means of disconnection is not otherwise provided.
- b. Welded Joints: Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ASME B31.8.
- c. Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.
- d. Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted.

- e. Painting: Paint new ferrous metal piping, including supports, in accordance with Section 09 90 00 PAINTS AND COATINGS. Do not apply paint until piping tests have been completed.
- f. Identification of Piping: Identify piping aboveground in accordance with MIL-STD-101, using adhesive-backed or snap-on plastic labels and arrows. In lieu of labels, identification tags may be used. Apply labels or tags to finished paint at intervals of not more than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.1.2.3 Wrapping

Where connection to existing steel line is made underground, tape wrap new steel transition fittings and exposed existing pipe having damaged coating. Clean pipe to bare metal. Initially stretch first layer of tape to conform to the surface while spirally half-lapping. Apply a second layer, half-lapped and spiraled as the first layer, but with spirals perpendicular to first wrapping. Use 10 mil minimum thick polyethylene tape. In lieu of tape wrap, heat shrinkable 10 mil minimum thick polyethylene sleeve may be used.

3.1.3 Valves

Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally.

3.1.3.1 Pressure Regulator

Pressure Regulators and Meters shall be in accordance with NFPA 58, Liquefied Petroleum Gas Code the following:

- (a) All pressure regulators for outdoor installations shall be designed, installed, or protected so their operation will not be affected by the elements (freezing rain, sleet, snow, ice, mud, or debris).
- (b) Each meter or pressure regulator installed outside of a building, must be installed in a readily accessible location not less than 18 inches aboveground and be protected from corrosion and other damage, including, vehicular damage that may be anticipated.
- (c) An accessible approved manual shutoff valve with a nondisplaceable valve member shall be provided upstream of each gas pressure regulator or regulator/meter assembly.
- (d) Each meter must be located in a ventilated place and not less than 3 feet from any source of ignition or any source of heat which might damage the meter.
- (e) Each meter and each regulator must be installed so as to minimize anticipated stresses upon the connecting piping and the meter.
- (f) Pressure regulator vents and relief vents must terminate outdoors, and the outdoor terminal must:
 - (1) Be rain and insect resistant;
 - (2) Be located at a place where gas from the vent can escape freely

into the atmosphere and away from any opening into the building;
and

(3) Be protected from damage caused by submergence in areas where flooding may occur.

(g) Pressure regulators shall be provided with a means to determine the outlet pressure, or a 1/4 inch gage tap, with plug, shall be installed as close as practical, not to exceed 12 inches, to the regulator outlet in the downstream piping.

3.1.3.2 Stop Valve and Shutoff Valve

Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.1.4 Pipe Sleeves

Comply with Section 07 84 00 FIRESTOPPING. Pack annular space with oakum, and caulk at ends with silicone construction sealant.

3.1.5 Piping Hangers and Supports

Selection, fabrication, and installation of piping hangers and supports shall conform with MSS SP-69 and MSS SP-58, unless otherwise indicated. Provide seismic restraints in accordance with SMACNA 1981.

3.1.6 Final Connections

Make final connections to equipment and appliances using rigid pipe and fittings. Final connection to the burner cabinets will be made by others under a separate contract.

3.2 FIELD QUALITY CONTROL

3.2.1 Metal Welding Inspection

Inspect for compliance with NFPA 54 and ASME B31.8. Replace, repair, and then re-inspect defective welds.

3.2.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.2.3 System Purging

After the completion of the piping installation and after completing pressure tests, and before testing a gas contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54, NFPA 58 and ASME B31.8.

-CAUTION-

Failure to purge may result in
explosion within line when air-to-gas
is at correct mixture.

-- End of Section --

SECTION 33 51 15

NATURAL-GAS / LIQUEFIED PETROLEUM GAS DISTRIBUTION
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.

AMERICAN GAS ASSOCIATION (AGA)

AGA XR0603 (2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L (2012) Specification for Line Pipe

API Std 1104 (2013; Errata 1-3; Addendum 1 2014) Welding of Pipeline and Related Facilities

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203 (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C213 (2007) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)

ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.5 (2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9 (2012) Standard for Factory-Made Wrought Steel Buttwelding Fittings

ASME B31.8 (2013) Gas Transmission and Distribution Piping Systems

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASME PTC 25 (2014) Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)

ASTM A135/A135M (2009; R2014) Standard Specification for
Electric-Resistance-Welded Steel Pipe

ASTM A139/A139M (2004; R 2010) Standard Specification for
Electric-Fusion (ARC)-Welded Steel Pipe
(NPS 4 and over)

ASTM A181/A181M (2013) Standard Specification for Carbon
Steel Forgings, for General-Purpose Piping

ASTM A53/A53M (2012) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM D3308 (2012) PTFE Resin Skived Tape

ASTM D3350 (2012) Polyethylene Plastics Pipe and
Fittings Materials

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

MSS SP-110 (2010) Ball Valves Threaded,
Socket-Welding, Solder Joint, Grooved and
Flared Ends

MSS SP-25 (2013) Standard Marking System for Valves,
Fittings, Flanges and Unions

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and
Threaded Ends

MASTER PAINTERS INSTITUTE (MPI)

MPI 10 (Oct 2009) Exterior Latex, Flat, MPI Gloss
Level 1

MPI 11 (Oct 2009) Exterior Latex, Semi-Gloss, MPI
Gloss Level 5

MPI 119 (Oct 2009) Exterior Latex, Gloss

MPI 9 (Oct 2009) Exterior Alkyd, Gloss, MPI
Gloss Level 6

NACE INTERNATIONAL (NACE)

NACE SP0185 (2007) Extruded Polyolefin Resin Coating
Systems with Soft Adhesives for
Underground or Submerged Pipe

NACE SP0274 (1974; R 2011) High Voltage Electrical
Inspection of Pipeline Coatings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2015) National Fuel Gas Code
NFPA 58	(2014; TIA 13-1; TIA 13-2; Errata 13-1; TIA 13-3; Errata 14-2) Liquefied Petroleum Gas Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
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 1	(1982; E 2004) Solvent Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

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

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
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UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE	(2012) Flammable and Combustible Liquids and Gases Equipment Directory
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1.2 SYSTEM DESCRIPTION

The gas distribution system includes propane gas piping and appurtenances from point of connection with existing system, as indicated, to a point within the facility as indicated. Section 31 23 00.00 20 EXCAVATION AND FILL, applies to this section unless otherwise specified. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Submit Data packages, as specified.

1.2.1 Gas Distribution System and Equipment Operation

Include maps showing piping layout, locations of system valves, gas line markers and cathodic protection system test stations; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system maps); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data Package No. 4.

1.2.2 Gas Distribution System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No. 4.

1.2.3 Gas Distribution Equipment Maintenance

Include identification of valves and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

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

Pipe, Fittings, and Associated Materials

SD-03 Product Data

Materials and Equipment; G
Spare Parts; G
Pipe and Accessory Coatings; G
Plastic tubing for pneumatic system; G
Propane vapor meter; G

SD-05 Design Data

Connection and Abandonment Plan; G
Jointing of Polyethylene Piping; G

SD-06 Test Reports

Piping System Pressure and Leakage Test Requirements; G

SD-07 Certificates

Welder's training, qualifications and procedures; G

SD-10 Operation and Maintenance Data

Gas distribution system and equipment operation; G
Gas distribution system maintenance; G
Gas distribution equipment maintenance; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Welding General

- a. Submit a certificate of Welder's training, qualifications and procedures, in conformance with API Std 1104, for metal along with a list of names and identification symbols of performance qualified welders and welding

operators.

- b. Weld structural members in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.4.1.2 Jointing of Polyethylene Piping

- a. Join piping by performance qualified PE joiners, qualified by a person who has been trained and certified by the manufacturer of the pipe, using manufacturer's pre-qualified joining procedures in accordance with AGA XR0603. Inspect joints by an inspector qualified in the joining procedures being used and in accordance with AGA XR0603. Welders training, qualifications and procedures, (metal and PE) includes use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA XR0603.
- b. Submit a certificate of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors. Notify the Contracting Officer at least 24 hours in advance of the date to qualify joiners and inspectors.

1.4.2 Pre-Installation Conference

1.4.2.1 Shop Drawings

Submit shop drawings, within 30 days of contract award, containing complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the drawings proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.4.2.2 Connecting and Abandonment Plan

Submit written notification of the method and schedule for making connections to existing gas lines, to the Contracting Officer at least 15 days in advance. Include gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in conformance with ASME B31.8 Include in submittal connection and abandonment plan.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

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

1.5.2 Handling

Handle pipe and components carefully to ensure a sound, undamaged condition. Take particular care not to damage pipe coating. Repair damaged coatings to original finish. Do not place pipe or material of any kind inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Handle steel piping with coal-tar enamel coating in accordance with AWWA C203, and fusion-bonded epoxy coatings per AWWA C213. Handle plastic pipe in conformance with

AGA XR0603.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of equipment and material specified, after approval of the detail shop drawings and not later than 1 month 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.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Provide written verification and point of contact for a supporting service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Mark all valves, flanges, and fittings in accordance with MSS SP-25. Submit a complete list of materials and equipment, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

- a. Dielectric Waterways and Flange Kits.
- b. Emergency Gas Supply Connection.
- c. Fittings
- d. Piping
- e. Pipe and Accessory coatings
- f. Pressure Reducing Valves.
- g. Meters
- h. Regulators.
- i. Shut-off Valves

2.1.1 Steel Pipe

API Spec 5L, Grade A, B, or X42, ASTM A53/A53M, Grade A or B, ASTM A135/A135M, or ASTM A139/A139M, Grade A or B, Schedule 40. Do not coat pipe and fittings for aboveground lines. Provide butt weld wrought steel fittings, conforming to ASME B16.9, Schedule 40. Provide forged steel socket weld and threaded fittings, conforming to ASME B16.11. Verify that pipe wall thickness conforms to ASME B31.8 for larger sizes and high pressures.

2.1.2 Small Fittings

For sizes 1-1/2 inches and smaller, provide fittings conforming to ASME B16.11.

2.1.3 Fittings, 2 inches and Larger

Provide pipe flanges and flanged fittings, including bolts, nuts, and bolt patterns in accordance with ASME B16.5, Class 150. Provide butt weld fittings in accordance with ASME B16.9. Use weld neck flanges.

2.1.4 Steel Forged Branch Connections

Provide steel forged branch connections conforming to ASTM A181/A181M, Class 60, carbon steel.

2.1.5 Flange Gaskets

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

2.1.6 Pipe Threads

Provide threaded pipe conforming to ASME B1.20.1.

2.1.7 Corrugated Stainless Steel Piping Aboveground to Buildings and Vaults

2.1.7.1 Manifolds

Malleable iron, steel or copper alloy with threaded connections/ports in accordance with ASME B1.20.1

2.1.8 Sealants for Steel Pipe Threaded Joints

2.1.8.1 Sealing Compound

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less.

2.1.8.2 Tape

Provide polytetrafluoroethylene tape conforming to ASTM D3308.

2.1.9 Identification

Provide pipe flow markings and metal tags for each valve, meter, and regulator as required by the Contracting Officer.

2.1.10 Insulating Joint Materials

Provide insulating joint materials between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.10.1 Threaded Joints

For threaded pipe joints, provide steel body nut type, dielectric waterways with insulating gaskets.

2.1.10.2 Flanged Joints

For flanged pipe joints, provide full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

2.1.10.3 Dielectric Waterways and Flanges

Provide dielectric waterways with temperature and pressure rating equal to or greater than that specified for the connecting piping, with metal connections on both ends suited to match connecting piping. Provide internally lined dielectric waterways, lined with an insulator specifically designed to prevent current flow between dissimilar metals, meeting the performance requirements described herein for dielectric waterways.

2.1.11 Gas Transition Fittings

Provide manufactured steel gas transition fittings approved for jointing steel and polyethylene pipe, conforming to AGA XR0603 requirements for transition fittings.

2.2 VALVES

Provide valves suitable for shutoff or isolation service and conforming to MSS SP-110, MSS SP-78 and the following:

2.3 PRESSURE REGULATORS

Provide ferrous bodied regulators with backflow protection, designed to meet the pressure, load and other service conditions.

2.3.1 Gas Main Regulators

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

- a. Spring-loaded relief valve meeting the provisions of ASME BPVC SEC VIII D1.
- b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system will cause the regulator to open.
- c. Weight-loaded relief valves conforming to ASME PTC 25.
- d. Monitoring regulator installed in series with the primary pressure regulator.
- e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.
- f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less, which remains closed until manually reset.
- g. Spring-loaded, diaphragm type relief valves.

2.4 METERS

2.4.1 Vapor Meter

The propane vapor meter shall be turbine type gas meter incorporating remote-read capability. The vapor meter maximum working pressure shall be 275 psig. The vapor meter capacity shall be 30,000 ACFH. The remote-read, meter-mounted instrument shall automatically correct flowing gas volume in accordance with Boyle's and Charles' laws. The correct volume shall be registered to base conditions of pressure (14.65 inches) water column and temperature (60 degrees F). The Pressure Range shall be at least of 60 psig.

2.5 PROTECTIVE COVERING MATERIALS

Provide a continuously extruded polyethylene and adhesive coating system material conforming to NACE SP0185, Type A.

2.6 PLASTIC TUBING FOR PNEUMATIC SYSTEM

Provide totally PE piping. Prior to installation, obtain printed instructions and technical assistance in proper installation techniques from pipe manufacturer. When joining new PE pipe to existing pipe line, ascertain what procedural changes in the fusion process is necessary to attain optimum bonding.

- a. PE Piping: Prior to installation, Contractor shall have supervising and installing personnel, certified in accordance with paragraph entitled "Welder's Qualifications." Provide fusion-welded joints except where transitions have been specified. Use electrically heated tools, thermostatically controlled and equipped with temperature indication. (Where connection must be made to existing plastic pipe, contractor shall be responsible for determination of compatibility of materials and procedural changes in fusion process necessary to attain maximum integrity of bond.)
- b. Laying PE Pipe: Bury pipe 24 inches below finish grade or deeper when indicated. Lay in accordance with manufacturer's printed instructions.

Tubing shall be Polyethylene per ASTM D3350, class 1213100C; shall be at least 1/4 inch I.D. with a Wall Thickness of .040 inch +/- .003, and shall have a burst pressure of 400 psig. Connections shall be made with compression type fittings incorporating an internal stiffener.

Tubing shall be installed in the same trench as the metallic gas piping. The separation between the metallic piping and the plastic tubing shall be not less than 6 inches. The plastic tubing shall have not less than 18 inches of ground cover and shall be protected where passing under roadways or vehicle traffic paths.

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 EXCAVATION AND BACKFILLING

Earthwork is as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

3.3 SERVICE LINES

3.3.1 General

Construct service lines of materials specified. The point of delivery is the meter set assembly. Connect the service lines as indicated with end of run plugged. Where indicated, provide service line with an isolation valve of the same size as the service line. Make the service lines as short and as straight as practicable between the point of delivery and the gas main, without bends or lateral curves unless necessary to avoid obstructions or otherwise permitted. Lay service lines with as few joints as practicable using standard lengths of pipe, use shorter lengths only for closures. Do not install polyethylene service lines aboveground except as permitted in ASME B31.8.

3.4 WORKMANSHIP AND DEFECTS

Make pipe, tubing, and fittings clear and free of cutting burrs and defects in structure or threading, and thoroughly brushed and blown free of chips and scale. Do not repair, but replace defective pipe, tubing, or fittings.

3.5 PROTECTIVE COVERING

3.5.1 Protective Covering for Underground Steel Pipe

Except as otherwise specified, apply protective coverings mechanically in a factory or field plant especially equipped for the purpose. Hand apply protective covering to valves and fittings that cannot be coated and wrapped mechanically, preferably at the plant that applies the covering to the pipe. Coat and wrap joints by hand, in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

3.5.1.1 Thermoplastic Resin Coating System

Provide a thermoplastic coating system conforming to NACE SP0185, Type A. Clean the exterior of the pipe to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE No.3, and apply adhesive compound to the pipe. Immediately after the adhesive is applied, extrude a seamless tube of polyethylene over the adhesive to produce a bonded seamless coating, with a nominal thickness of 10 mils (plus or minus 10 percent) of adhesive and 40 mils (plus or minus 10 percent) of polyethylene for pipes up to 16 inches in diameter. For pipes 18 inches and larger in diameter, apply a minimum thickness to the pipe of 10 mils (plus or minus 10 percent) adhesive and 60 mils (plus or minus 10 percent) polyethylene. Apply joint coating and field repair material as recommended by the coating manufacturer, consisting of one the following:

- a. Heat shrinkable polyethylene sleeves.
- b. Polyvinyl chloride pressure-sensitive adhesive tape.
- c. High density polyethylene/bituminous rubber compound tape.

Inspect the coating system for holes, voids, cracks, and other damage

during installation.

3.5.1.2 Inspection of Pipe Coatings

Repair any damage to the protective covering during transit and handling before installation. After field coating and wrapping has been applied, inspect the entire pipe using an electric holiday detector with impressed current set at a value in accordance with NACE SP0274 using a full-ring, spring-type coil electrode. Equip the holiday detector with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Immediately repair all holidays in the protective covering upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Furnish labor, materials, and equipment necessary for conducting the inspection.

3.5.2 Protective Covering for Aboveground Piping Systems

Apply finish painting conforming to the applicable paragraphs of Section 09 90 00 PAINTS AND COATINGS and as follows:

3.5.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer of the same type paint as the shop primer. Solvent-clean surfaces that have not been shop primed in accordance with SSPC SP 1. Mechanically clean surfaces that contain loose rust, loose mill scale, and other foreign substances by power wire brushing in accordance with SSPC SP 3 or brush-off blast clean in accordance with SSPC 7/NACE No.4 and primed with ferrous metal primer in accordance with SSPC Paint 25. Finish primed surfaces with two coats of exterior alkyd paint conforming to MPI 9.

3.5.2.2 Nonferrous Surfaces

Paint nonferrous surfaces to corrosive conditions. Solvent-clean the surfaces in accordance with SSPC SP 1. Apply a first coat of MPI 10, and 2 coats of MPI 119 or MPI 11.

3.6 INSTALLATION

Install gas distribution system and equipment in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA XR0603 and 49 CFR 192 and NFPA 58. Cut the pipe without damaging the pipe; unless otherwise authorized, use an approved type of mechanical cutter. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cut plastic pipe in accordance with AGA XR0603. Design valve installation in plastic pipe to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box. Install polyethylene mains and service lines for LPG only below ground in accordance with NFPA 58. Install gas piping, appliances, and equipment in accordance with NFPA 54 and in compliance with the CSST manufacturer's installation instructions. Install distribution piping in accordance with ASME B31.8 and NFPA 58.

3.6.1 Installing Pipe Underground

Grade gas mains and service lines as indicated. Weld joints in steel pipe except as otherwise permitted for installation of valves. Provide mains with 24 inch minimum cover; service lines with 18 inch minimum cover; and

place both mains and service lines on firmly compacted select material for the full length. Provide standard weight black steel pipe encasement material with a protective coating. Separate the pipe from the casing by insulating spacers and seal the ends with casing bushings. Excavate the trench below pipe grade, bed with bank sand, and compact to provide full-length bearing. Laying pipe on blocks to produce uniform grade is not permitted. Ensure that the pipe is clean inside before it is lowered into the trench and keep free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, securely close open ends of pipe or fittings with expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Make changes in line or gradient that exceed the limitations specified with fittings. When cathodic protection is furnished, provide electrically insulated joints or flanges. When polyethylene piping is installed underground, place foil backed magnetic tape above the pipe in accordance with NFPA 54 to permit locating with a magnetic detector. After laying of pipe and testing, backfill the trench in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

3.6.2 Installing Pipe Aboveground

Protect aboveground piping against dirt and other foreign matter, as specified for underground piping. Weld joints in steel pipe ; however, joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Provide flanges of the weld neck type to match wall thickness of pipe.

3.7 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.7.1 Threaded Steel Joints

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

3.7.2 Welded Steel Joints

Perform gas pipe weldments as indicated. Make changes in direction of piping by welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Use forged or flared branch outlet fittings for improvement of flow where attached to the run, and reinforced against external strains. Perform all beveling, alignment, heat treatment, and inspection of welds conforming to ASME B31.8. Remove weld defects and repair the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect it or store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.7.3 Connections Between Metallic and Plastic Piping

Only make metallic to plastic connections outside, underground, and with approved transition fittings.

3.8 PRESSURE REGULATOR INSTALLATION

3.8.1 Main Distribution Line Regulators

Install pressure regulators where shown. Install a valve on each side of the regulator for isolating the regulator for maintenance. Locate discharge stacks, vents, or outlet ports of all pressure relief devices where gas can be discharged into the atmosphere without undue hazard. Provide stacks and vents with fittings to preclude entry of water.

3.8.2 Service Line Regulators

Install a shutoff valve, meter set assembly, and service regulator on the service line outside the building, 18 inches above the ground on the riser. Install an insulating joint on the inlet side of the meter set assembly and service regulator and construct to prevent flow of electrical current. Provide a 3/8 inch tapped fitting equipped with a plug on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.9 METER INSTALLATION

Install meters in accordance with ASME B31.8. Install permanent gas meters with provisions for isolation and removal for calibration and maintenance, and suitable for operation in conjunction with an energy monitoring and control system.

3.10 CATHODIC PROTECTION

Provide cathodic protection for all metallic gas piping installed underground and install as specified in Section 26 42 14.00 10 - CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE).

3.11 TESTS

3.11.1 Destructive Tests of Plastic Pipe Joints

Prior to making polyethylene heat fusion joints, make a joint of each size and type to be installed that day by each person performing joining of plastic pipe that day and destructively test. Cut at least 3 longitudinal straps from each joint. Visually examine each strap for voids or discontinuities on the cut surfaces of the joint area, deformations by bending, torque, or impact. If failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint is not allowed to make further field joints in plastic pipe on this job until that joiner has been retrained and re-qualified. Record the results of the destructive tests including the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.11.2 Piping System Pressure and Leakage Test Requirements

3.11.2.1 General

No person may operate a new segment of pipeline, or return to service a segment of pipeline that has been relocated or replaced, until-

1. It has been visually inspected pressure tested to determine that the materials, design, fabrication, and installation practices comply with the requirements of applicable codes, and
2. Each potentially hazardous leak has been located and eliminated.

Inspection shall consist of visual examination, during or after manufacture, fabrication, assembly, or pressure tests.

Where repairs or additions are made following the pressure test, the affected piping shall be tested. Minor repairs and additions are not required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other leak-detecting methods approved by the authority having jurisdiction.

Prior to testing, the interior of the pipe shall be cleared of all foreign material.

The test medium shall be air, nitrogen, carbon dioxide, or an inert gas.

1. OXYGEN SHALL NEVER BE USED

Pipe joints, including welds, shall be left exposed for examination during the test.

Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

Appliances and equipment that are not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.

1. Where the piping system is connected to appliances or equipment designed for operating pressures of less than the test pressure, such appliances or equipment shall be isolated from the piping system by disconnecting them and capping the outlet(s).
2. Where the piping system is connected to appliances or equipment designed for operating pressures equal to or greater than the test pressure, such appliances or equipment shall be isolated from the piping system by closing the individual appliance or equipment shutoff valve(s).

All testing of piping systems shall be performed in a manner that protects the safety of employees and the public during the test.

Test pressure shall be measured with a manometer or with a pressure measuring device designed and calibrated to read, record, or indicate a pressure loss due to leakage during the pressure test period. The source of pressure shall be isolated before the pressure tests are made. Mechanical gauges used to measure test pressures shall have a range such

that the highest end of the scale is not greater than 5 times the test pressure.

The test pressure to be used shall be no less than 1-1/2 times the proposed maximum working pressure, but not less than 3 psi (20 kPa), irrespective of design pressure. Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.

The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

The leakage shall be located by means of an approved gas detector, a noncorrosive leak detection fluid, or other approved leak detection methods.

Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

3.11.2.2 Piping systems operating at greater than 100 psig

Piping systems operating at greater than 100 psig. After installation or modification, piping systems (including hose) shall be proven free of leaks by performing a pressure test at not less than the normal operating pressure.

B. The test pressure to be used shall be no less than 1-1/2 times the proposed maximum working pressure, irrespective of design pressure. Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength (SMYS) of the pipe.

Test pressure shall not be less than 100 psig.

3.11.2.3 Piping systems operating at pressures less than 100 psig, but greater than 40 psig.

The test pressure to be used shall be no less than 1-1/2 times the proposed maximum working pressure or 90 psig, whichever is greater.

Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength (SMYS) of the pipe.

3.11.2.4 Piping systems operating at less than 40 psig

The test pressure used shall be no less than 1-1/2 times the proposed maximum working pressure, but not less than 3 psig, irrespective of design pressure.

3.11.2.5 Leak Check

Immediately after the gas is turned on into a new system or into a system that has been initially restored after an interruption of service, the piping system shall be checked for leakage. Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

3.11.2.6 Records

A record of each test performed on the piping system shall be made.

The record shall include at least the following:

1. The name(s) of the employee responsible for making the test, and the name of any test company used;
2. Test medium used;
3. Test pressure;
4. Test duration;
5. Pressure recording charts, or other record of pressure readings;
6. Leaks and failures noted and their disposition.

Test records shall be maintained for not less than the useful life of the pipeline

3.11.3 Meter Test

Test meter to verify data transfer to data collection server and validate calibration of both meter and the data that is received by the data collection server.

-- End of Section --

SECTION 33 52 80

LIQUID FUELS PIPELINE COATING SYSTEMS

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 WATER WORKS ASSOCIATION (AWWA)

- | | |
|-----------|---|
| AWWA C203 | (2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied |
| AWWA C209 | (2013) Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines |
| AWWA C210 | (2007) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| AWWA C213 | (2007) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines |
| AWWA C215 | (2010) Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines |
| AWWA C216 | (2007) Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines |
| AWWA C217 | (2009) Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines |

ASTM INTERNATIONAL (ASTM)

- | | |
|------------|---|
| ASTM D3276 | (2007) Painting Inspectors (Metal Substrates) |
|------------|---|

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- | | |
|----------|--|
| ISO 9001 | (2008; Corr 1 2009) Quality Management Systems- Requirements |
|----------|--|

NACE INTERNATIONAL (NACE)

- | | |
|-------------|--|
| NACE RP0402 | (2002) Field-Applied Fusion-Bonded Epoxy (FBE) Pipe Coating Systems for Girth Weld Joints: Application, Performance, and Quality Control |
|-------------|--|

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC QP 1	(2012; E 2012) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 3	(2010) Standard Procedure for Evaluating Qualifications of Shop Painting Applicators
SSPC QP 5	(2012) Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies
SSPC QS 1	(2004) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP COM	(2004) Surface Preparation Commentary for Steel and Concrete Substrates
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

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

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.134	Respiratory Protection

1.2 SYSTEM DESCRIPTION

This section specifies the requirements for exterior coating of aboveground and buried, carbon steel, liquid fuel pipelines. The exterior coating system for buried pipelines is extruded polyethylene system or fusion bonded epoxy coating.

1.3 SUBMITTALS

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

SD-03 Product Data

Field-Applied External Pipe Coating

SD-06 Test Reports

Qualification Testing of Shop-Applied External Pipe Coating

Acceptance Testing Qualification Testing of Field-Applied External Pipe Coating

Inspection Report Forms

Daily Inspection Reports

SD-07 Certificates

Contract Errors, Omissions, and Other Discrepancies

Corrective Action Procedures

Coating Work Plan

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications of Pipe Coating Shop

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company for Field Coating

Qualifications of Coating Inspector for Field Coating

Qualifications Of Individuals Performing Abrasive Blasting for
Field Coating

Qualifications of Individuals Performing Coating Application for
Field Coating

Qualifications of Individuals Performing Coating Application for
Field Coating

Qualifications of Individuals Operating Plural Component Equipment
(Pump Tenders) for Field Coating

Qualifications of Coating Contractors

SD-11 Closeout Submittals

Inspection Logbook

1.4 QUALITY ASSURANCE

1.4.1 Contract Errors, Omissions, and Other Discrepancies

Submit all errors, omissions, and other discrepancies in contract documents to the Contracting Officer within 30 days of contract award for all work covered in this Section, other than the work that will not be uncovered until a later date. All such discrepancies shall be addressed and resolved, and the Coating Work Plan modified, prior to beginning the Initial and Follow-Up phases of work. Discrepancies that become apparent only after work is uncovered shall be identified at the earliest discoverable time and submitted for resolution. Schedule time (Float) should be built into the project schedule at those points where old work is to be uncovered or where access is not available during the first 30 days after award, to allow for resolution of contract discrepancies.

1.4.2 Corrective Action (CA)

CA shall be included in the Quality Control Plan.

1.4.2.1 Corrective Action Procedures

Develop procedures for determining the root cause of each non-compliance, developing a plan to eliminate the root cause so that the non-compliance does not recur, and following up to ensure that the root cause was eliminated. Develop Corrective Action Request (CAR) forms for initiating CA, and for tracking and documenting each step.

1.4.2.2 Implement Corrective Action

The Contractor shall take action to identify and eliminate the root cause of each non-compliance so as to prevent recurrence. These procedures shall apply to non-compliance in the work, and to non-compliance in the QC System. Corrective actions shall be appropriate to the effects of the non-compliance encountered. Each CAR shall be serialized, tracked in a Log to completion and acceptance by the Contracting Officer, and retained in project records. The Corrective Action Log, showing status of each CAR, shall be submitted to the Contracting Officer monthly. A CAR may be initiated by either the Contractor or the Contracting Officer. The Contracting Officer must approve each CAR at the root cause identification stage, the plan for elimination stage, and the close out stage after verification that the root cause has been eliminated.

1.4.3 Coating Work Plan

Provide procedures for reviewing contract documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.

Provide procedures for verification of key processes during Initial Phase to ensure that contract requirements can be met. Key processes shall include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.

Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of non-compliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

Provide procedures for correcting non-compliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to handle correct coating thickness non-compliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.

If a procedure is based on a proposed or approved request for deviation, the deviation shall be referenced. Changes to procedures shall be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

1.4.4 Qualifications

The qualifications specified in this paragraph must be met throughout the duration of this contract. No work that is subject to specified qualifications shall be provided by personnel or corporate entities unless all specified qualifications are met.

1.4.4.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

1.4.4.2 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS, including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS shall not be the designated coating inspector.

1.4.4.3 Qualifications of Coating Inspection Company for Field Coating

Submit documentation that the selected coating inspection company is certified by SSPC to the requirements of SSPC QP 5 prior to contract award. The coating inspection company must remain so certified for the duration of the project.

1.4.4.4 Qualifications of Coating Inspector for Field Coating

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level III, by the selected coating inspection company.

1.4.4.5 Qualifications Of Individuals Performing Abrasive Blasting for Field Coating

All individuals performing abrasive blasting shall be certified by SSPC to the SSPC C-7 Dry Abrasive Blaster Qualification Program, and shall remain certified during the entire period of coating application. Submit name, address, telephone number, and evidence of certification of each person that will be performing abrasive blasting.

This requirement applies to all manual abrasive blasting performed in shop and field locations. This requirement does not apply to automated abrasive blasting performed in the shop.

1.4.4.6 Qualifications of Individuals Performing Coating Application for Field Coating

All individuals performing coating application shall be certified by SSPC to either the SSPC C-12 Marine/Industrial Airless Spray Program or to the SSPC C-15 Plural Component Spray Program; Spray Painter Category, and shall remain certified during the entire period of coating application. Submit name, address, telephone number, and evidence of certification of each person that will be performing coating application by any method.

1.4.4.7 Qualifications of Individuals Operating Plural Component Equipment (Pump Tenders) for Field Coating

All individuals operating plural component equipment shall be certified by SSPC to the SSPC C-15 Plural Component Spray Program; Equipment Operator Category, and shall remain certified during the entire period of coating application. Submit name, address, telephone number, and evidence of certification of each person that will be operating plural component equipment.

1.4.4.8 Qualifications of Pipe Coating Shop

Each shop that applies coatings to pipe shall be certified to either ISO 9001 or SSPC QP 3, Class A prior to contract award.

1.4.4.9 Qualifications of Coating Contractors for Field Coating

All Contractors and Subcontractors that perform surface preparation or coating application shall be certified to either ISO 9001 or SSPC QP 1 and SSPC QS 1 prior to contract award.

1.4.5 Protective Coating Specialist (PCS)

The PCS shall be considered a QC Specialist and shall report to the QC Manager, as specified in Section 01 45 00.00 20 QUALITY CONTROL. The PCS shall approve all submittals prior to submission to the QC Manager for approval or submission to the government for approval.

1.4.6 Pre-Application Meeting For Field Coating

After approval of submittals but prior to the initiation of coating work, Contractor representatives, including at a minimum, project superintendent and QC manager, paint foreman, coating inspector, and PCS shall have a pre-application coating preparatory meeting. This meeting shall be in addition to the pre-construction conference. Specific items addressed shall include: corrective action requirements and procedures, coating work plan, safety plan, coordination with other Sections, inspection standards, inspection requirements and tools, test procedures, environmental control system, safety plan, and test logs. Notify Contracting Officer at least ten days prior to meeting.

1.5 DELIVERY AND STORAGE

Ship, store, and handle materials in accordance with SSPC PA 1, applicable standards, and as modified in this Section. Maintain temperature in storage spaces between 40 and 75 degrees F, and air temperature more than 5 degrees F above the dew-point at all times. Inspect materials for damage and return non-compliant materials to manufacturer. Remove materials with expired shelf life from government property immediately and notify the

Contracting Officer. Expired materials may be returned to manufacturer, tested, and if compliant, issued a shelf life extension.

1.6 COATING HAZARDS

Ensure that employees are trained in all aspects of the safety plan. Specified coatings may have potential health hazards if ingested or improperly handled. The coating manufacturer's written safety precautions shall be followed throughout mixing, application, and curing of the coatings. During tank cleaning, cleanup, surface preparation, and paint application phases, ensure that employees are protected from toxic and hazardous chemical agents which exceed concentrations in 29 CFR 1910.1000. Comply with respiratory protection requirements in 29 CFR 1910.134. The CIH shall approve work procedures and personal protective equipment.

1.7 JOB SITE REFERENCES - SHOP

Make available to the Contracting Officer a copy of each standard to which the shop will be applying coating under this Section.

1.8 JOB SITE REFERENCES - FIELD

Make available to the Contracting Officer at least one copy each of AWWA C203, AWWA C209, AWWA C210, AWWA C215, AWWA C216, AWWA C217, ISO 9001, SSPC PA 1, SSPC QP 1, SSPC QP 3, SSPC QS 1, SSPC SP COM, SSPC SP 10/NACE No. 2, and an SSPC Certified Contractor Evaluation Form at the job site.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

2.1.1 Test Requirements

Qualification testing of coating materials and coating system performance requirements shall be based on laboratory testing of identical materials used in production, tested within the last two years. All required and optional tests shall be performed. Acceptance of each batch of production coating materials may be based on laboratory testing or manufacturer's certificate of conformity.

Acceptance testing of Extruded Polyolefin coated pipe shall be based on all required production verification testing required by AWWA C215. Perform optional production verification testing described in paragraph OPTIONAL COATING PERFORMANCE TESTING OF COATED PIPE of AWWA C213, including cross-section porosity, interface porosity, thermal analysis (DSC), permanent strain (bendability), and interfacial contamination. Perform production verification testing on a minimum of one pipe joint in the first half hour of production each day, and on a minimum of one pipe joint in the last half hour of production each day. Perform additional testing as required to segregate any non-compliant material. Testing may be performed using qualified in-house personnel and facilities, or by independent laboratory. Submit results of tests as proof of compliance. Document compliance with the approved Coating Work Plan.

2.1.2 Shop Inspection

2.1.2.1 Inspection Requirements

Provide all tools and instruments required to perform the required testing, as well as any tools or instruments that the inspector considers necessary to perform the required inspections and tests. Document each inspection and test, including required hold points and other required inspections and tests, as well as those inspections and tests deemed prudent from on-site evaluation to document a particular process or condition, as follows:

- a. Location or area;
- b. Purpose (required or special);
- c. Method;
- d. Criteria for evaluation;
- e. Results;
- f. Determination of compliance;
- g. List of required rework;
- h. Observations.

Collect and record Environmental Conditions as described in ASTM D3276 on a 24 hour basis, from beginning of surface preparation through initial curing of coating, as follows:

- a. During surface preparation, every two hours or when changes occur;
- b. During coating application and the first four days of initial cure, every hour, or when changes occur;
- c. Note location, time, and temperature of the highest and lowest surface temperatures each day;
- d. Use a non-contact thermometer to locate temperature extremes, then verify with contact thermometers.

Document all equipment used in inspections and testing, including manufacturer, model number, serial number, last calibration date and future calibration date, and results of on-site calibration performed.

Document Contractors compliance with the approved Coating Work Plan.

2.1.2.2 Inspection Report Forms

Develop project-specific report forms as required to report measurements, test results, and observations being complete and conforming to contract requirements. This includes all direct requirements of the contract documents and indirect requirements of referenced documents. Show acceptance criteria with each requirement and indication of conformity of each inspected item. The data may be in any format, but must be legible and presented so that entered data can be quickly compared to the appropriate requirement.

2.1.2.3 Daily Inspection Reports

Submit one copy of daily inspection report completed each day when performing work under this Section, to the Contracting Officer. Note all non-compliance issues, and all issues that were reported for rework in accordance with QC procedures of Section 01 45 00.00 20 QUALITY CONTROL. Each report shall be signed by the coating inspector and the QC Manager. Submit report within 24 hours of date recorded on the report.

2.1.2.4 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use of each device.

PART 3 EXECUTION

3.1 FIELD EXTERIOR COATING OF ABOVEGROUND PIPING

Coat aboveground piping in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD REPAIRS TO EXTERNAL COATING OF BURIED PIPING

3.2.1 Field-Applied External Pipe Coating

Use one or more of the following repair methods, as modified herein, to repair shop applied coatings and coat external girth welds:

- a. Coal Tar Enamel: AWWA C203, Type II enamel, Type III outerwrap
- b. Coal Tar Tape: AWWA C203
- c. Cold Applied Tape: AWWA C209
- d. Petrolatum or Petroleum Wax Tape Coating: AWWA C217
- e. Heat Shrink Sleeve: AWWA C216
- f. Fusion-Bonded Epoxy (FBE) Coating: NACE RP0402, coating material to be same as applied to pipe in shop
- g. Liquid-Epoxy Coating System: AWWA C210

3.2.2 Surface Preparation

Prepare girth welds, and repairs to bare steel, to SSPC SP 10/NACE No. 2 immediately prior to coating application. Verify that prepared surfaces comply with SSPC VIS 1 at time of coating application. All other surfaces shall be prepared in accordance with the appropriate coating standard referenced herein.

Block or suspended pipeline at a height that will allow the blast nozzle to be perpendicular to the surface being blasted, and at the proper standoff distance, at all times.

3.2.3 Soluble Salt Testing

3.2.3.1 Test Kit for Measuring Chloride, Sulfate and Nitrate Ions on Steel and Coated Surfaces

Test kit shall meet the following requirements:

- a. Kit contains all materials, supplies, tools and instructions for field testing and on-site quantitative evaluation of chloride, sulfate and nitrate ions;
- b. Kit extract solution is acidic, factory pre-measured, pre-packaged, and of uniform concentration;
- c. Kit components and solutions are mercury free and environmentally friendly;
- d. Kit contains new materials and solutions for each test extraction;

- e. Extraction test container (vessel, sleeve, cell. etc.) creates a sealed, encapsulated environment during salt ion extraction;
- f. Test extract container is suitable for testing the following steel surfaces: horizontal (up/down configuration), vertical, flat, curved, smooth, pitted, and rough;
- g. All salt ion concentrations are directly measured in micrograms per square centimeter.

3.2.3.2 Pre-Preparation Testing for Soluble Salts Contamination

Test surfaces for soluble salts, and wash as required, prior to abrasive blasting. Soluble salt testing is also required in paragraph PRE-APPLICATION TESTING FOR SOLUBLE SALTS CONTAMINATION as a final acceptance test of prepared surfaces after abrasive blasting, and successful completion of this phase does not negate that requirement. This phase is recommended since pre-preparation testing and washing are generally more advantageous than attempting to remove soluble salt contamination after abrasive blasting. Effective removal of soluble salts will require removal of any barrier to the steel surface, including rust. This procedure may necessitate combinations of wet abrasive blasting, high pressure water rinsing, and cleaning using a solution of water washing and soluble salts remover. The soluble salts remover shall be acidic, biodegradable, nontoxic, noncorrosive, and after application, will not interfere with primer adhesion. Delays between testing and preparation, or testing and coating application, may allow for the formation of new contamination. Use potable water, or potable water modified with soluble salt remover, for all washing or wet abrasive blasting. Test methods and equipment used in this phase are selected at the Contractor's discretion.

3.2.3.3 Pre-Application Testing for Soluble Salts Contamination

Test girth welds and areas to be repaired for chloride contamination using the Test Kit described in paragraph TEST KIT FOR MEASURING CHLORIDE, SULFATE AND NITRATE IONS ON STEEL AND COATED SURFACES. One or more readings greater than 3 micrograms per square centimeter of chlorides or 10 micrograms per square centimeter of sulfates or 5 micrograms per square centimeter of nitrates is evidence of soluble salt contamination. Reject contaminated surfaces, wash as discussed in paragraph PRE-PREPARATION TESTING FOR SOLUBLE SALTS CONTAMINATION, allow to dry, and re-test until all required tests show allowable results. Reblast tested and cleaned areas as required. Label all test tubes and retain for test verification.

3.2.4 Coating Application

Apply coatings in accordance with SSPC PA 1 and as specified herein. Apply coatings to surfaces that meet all stated surface preparation requirements.

3.2.5 Final Inspection of Pipeline Prior to Burial

Verify that all surfaces of the pipeline are holiday-free at time of placement of backfill over pipe. Use holiday inspection requirements and acceptance criteria of the standards applicable to the coatings being tested.

3.3 PROJECT IDENTIFICATION

At the completion of the work, affix pertinent coating data on structure at

the tank farm that is readily accessible and visible from the ground. Use either stencils or nameplates. The following list generally describes the pertinent coating data, but should be modified as required to describe the coating systems.

Date coated/accepted: _____/_____
Project Number: _____
Contractor: _____
Address: _____
Coating System
Manufacturer: _____
Surface Prep: SSPC SP _____ Profile: _____
Primer: _____ Thickness: _____
Intermediate: _____ Thickness: _____
Topcoat: _____ Thickness: _____
Total Thickness: _____

3.3.1 Stencils

Use stencils on piping 8 in or larger. Use stencils with 3/4 to one inch Helvetica style letters and acrylic stencil paint of contrasting color.

3.3.2 Nameplates

Use nameplates for piping smaller than 8 in. Construct plates of anodized aluminum, 0.125 in thick, UV resistance, black with white center core, matte finish surface and square corners. Install nameplates in prominent locations with nonferrous screws, nonferrous bolts, or permanent adhesive. Minimum size of nameplates shall be one by 2.5 in. Lettering shall be the normal block style with a minimum 0.25 in height. Accurately align all lettering on nameplates.

3.4 FIELD QUALITY CONTROL

For marking of surfaces, use chalk for marking bare steel, and water based markers for marking coated surfaces, and remove marks prior to coating. Do not use any wax or grease based markers, or any other markers that leave a residue or stain.

3.4.1 Coating Inspector

The coating inspector shall be considered a QC Specialist and shall report to the QC Manager, as specified in Section 01 45 00.00 20 QUALITY CONTROL. The Coating Inspector shall be present during all pre-preparation testing, surface preparation, coating application, initial cure of the coating system, during all coating repair work, and during completion activities as specified in Section 01 45 00.00 20. The Coating Inspector shall provide complete documentation of conditions and occurrences on the job site, and be aware of conditions and occurrences that are potentially detrimental to the coating system. The requirements for inspection listed in this Section are in addition to the QC inspection and reporting requirements specified in Section 01 45 00.00 20 QUALITY CONTROL.

3.4.2 Field Inspection

3.4.2.1 Inspection Requirements

Perform field inspection in accordance with ASTM D3276 and the approved Coating Work Plan. Document Contractor's compliance with the approved

Coating Work Plan.

Provide all tools and instruments required to perform the required testing, as well as any tools or instruments that the inspector considers necessary to perform the required inspections and tests. Document each inspection and test, including required hold points and other required inspections and tests, as well as those inspections and tests deemed prudent from on-site evaluation to document a particular process or condition, as follows:

- a. Location or area;
- b. Purpose (required or special);
- c. Method;
- d. Criteria for evaluation;
- e. Results;
- f. Determination of compliance;
- g. List of required rework;
- h. Observations.

Collect and record Environmental Conditions as described in ASTM D3276 on a 24 hour basis, as follows:

- a. During surface preparation, every two hours or when changes occur;
- b. During coating application and the first four days of initial cure, every hour, or when changes occur;
- c. Note location, time, and temperature of the highest and lowest surface temperatures each day;
- d. Use a non-contact thermometer to locate temperature extremes, then verify with contact thermometers.

Document all equipment used in inspections and testing, including manufacturer, model number, serial number, last calibration date and future calibration date, and results of on-site calibration performed.

Document Contractors compliance with the approved Coating Work Plan.

3.4.2.2 Inspection Report Forms

Develop project-specific report forms as required to report measurements, test results, and observations being complete and conforming to contract requirements. This includes all direct requirements of the contract documents and indirect requirements of referenced documents. Show acceptance criteria with each requirement and indication of conformity of each inspected item. The data may be in any format, but must be legible and presented so that entered data can be quickly compared to the appropriate requirement.

3.4.2.3 Daily Inspection Reports

Submit one copy of daily inspection report completed each day when performing work under this Section, to the Contracting Officer. Note all non-compliance issues, and all issues that were reported for rework in accordance with QC procedures of Section 01 45 00.00 20 QUALITY CONTROL. Each report shall be signed by the coating inspector and the QC Manager. Submit report within 24 hours of date recorded on the report.

3.4.2.4 Inspection Logbook

A continuous record of all activity related to this Section shall be maintained in an Inspection Logbook on a daily basis. The logbook shall be

hard or spiral bound with consecutively numbered pages, and shall be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. The Coating Inspector's Logbook that is sold by NACE is satisfactory. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

3.4.2.5 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use of each device.

3.5 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

-- End of Section --

SECTION 33 56 53

PRESSURE VESSELS FOR STORAGE OF COMPRESSED GASES
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.

ASME INTERNATIONAL (ASME)

ASME B16.20	(2012) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.3	(2012) Process Piping
ASME BPVC SEC V	(2010) BPVC Section V-Nondestructive Examination
ASME BPVC SEC VIII D1	(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A182/A182M	(2014b) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	(2014) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2014) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A240/A240M	(2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A312/A312M	(2014b) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320/A320M	(2014) Standard Specification for Alloy/Steel and Stainless Steel Bolting

Materials for Low-Temperature Service

ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A376/A376M	(2014) Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM A403/A403M	(2014) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

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
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1982; E 2004) White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss)
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AS598	(2012) Aerospace Microscopic Sizing and Counting of Particulate Contamination for Fluid Power Systems
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- SD-02 Shop Drawings
 - Installation; G
- SD-07 Certificates
 - Cleaning

PART 2 PRODUCTS

2.1 MATERIALS

Use a nameplate on vessels except when stamping is directly applied. A nameplate plainly stamped in letters not less than 3/8 inch high shall be

permanently attached to vessel or vessel assembly structure at a conspicuous location. Attachment to shell or head portions or around the nozzle openings of vessel shall be by welding, brazing, soldering, or by tamper-resistant mechanical fasteners of suitable metal construction. Attachment by pressure sensitive adhesives of any type is not acceptable. Stamping shall show serial number, symbols of the manufacturer, specification number, date of manufacture, design pressure, test pressure, maximum allowable working pressure at operating temperature, minimum working temperature for vessels that operate, and water volume capacity in cubic feet to nearest tenth. Manifolds shall be identified by a stainless steel plate or tag attached by stainless steel bands or clamps and shall show serial number, if any, symbols of the manufacturer, specification number, date of manufacture, design pressure, and test pressure. Vessels shall be code stamped in accordance with ASME BPVC SEC VIII D1. Asbestos and asbestos-containing products will not be allowed.

2.1.1 Piping for Manifolds

Piping for manifolds shall be seamless stainless steel pipe or stainless steel tubing suitable for service and pressure through a temperature range of plus 120 to minus 125 degrees F, in accordance with ASME B31.3. Stainless steel pipe in thicknesses up to and including Schedule 80S shall conform to ASTM A312/A312M, Grade TP 304L or ASTM A376/A376M, Grade TP 304; thicknesses greater than Schedule 80S shall conform to ASTM A376/A376M, Grade TP 304.

2.1.2 Fittings for Manifolds

Fittings for manifolds shall be seamless butt-weld or socket-weld type and of material conforming to ASTM A403/A403M, Grade WP 304L, or if tubing is used, fittings shall be stainless steel positive mechanical high-pressure threaded type. Fittings shall be suitable for pressures specified for vessels and shall be compatible with manifold piping or tubing.

2.1.3 Flanges for Manifolds

Flanges for manifolds shall be of forged stainless steel conforming to ASTM A182/A182M, Grades F 304, F 316, or F 347. Flanges shall conform to ASME B16.5 where pressure-temperature ratings fall within limits established therein. For pressure-temperature outside such limits, flanges shall conform to Appendix 2 of ASME BPVC SEC VIII D1.

2.1.4 Bolts, Studs, and Nuts for Flanges

Bolts and studs for flanges for stainless steel manifolds shall be strain hardened and shall conform to ASTM A320/A320M, Grade B8 or equivalent age-hardened material. Nuts shall conform to ASTM A194/A194M, Grade 4, and shall be hexagonal American Standard Heavy Series. For manways and for other than stainless steel flanges, bolts and studs shall conform to ASTM A193/A193M, Grade B7, and nuts shall conform to ASTM A194/A194M, Grade 2H.

2.1.5 Flange Gaskets

Gaskets for ring type joint flanges shall be octagonal, fully annealed stainless steel ring type gaskets with dimensions conforming to ASME B16.20. Gaskets for helium service shall be oval type.

2.1.6 Supports and Attachments

Structural steel for supports or structural attachments shall conform to requirements specified for vessel or to ASTM A36/A36M. Where legs of ASTM A36/A36M steel are attached to stainless steel vessels, pads of ASTM A240/A240M steel shall be used to make the attachment.

2.2 DESIGN AND FABRICATION

2.2.1 Outlets

2.2.1.1 Manholes and Handholes

Manholes and handholes shall conform to the requirements of subsections UG-36 through UG-46 of ASME BPVC SEC VIII D1 as applicable.

2.2.1.2 Drains and Vents

Provide leakproof drains and vents to facilitate cleaning of vessels.

2.2.2 Pressure Relief Devices

All vessels, regardless of size or internal pressure, shall be provided with protective pressure relief devices conforming to the design requirements of parts UG-125 through UG-136 of ASME BPVC SEC VIII D1.

2.3 TESTING

Notify the Contracting Officer 15 days before the performance and fabrication tests are to be conducted. Perform tests in the presence of the Contracting Officer.

2.4 INSPECTION AND REPAIR OF DEFECTS

2.4.1 Personnel Qualifications

Radiographic, liquid penetrant and magnetic particle inspections of butt welded pipe joints and welded vessels listed below shall be performed by personnel qualified in accordance with applicable portion of ASME BPVC SEC V as appropriate. Certified test results shall be submitted by the reviewing inspector. Submit test reports for radiographic, magnetic particle, liquid penetrant, impact, and hydrostatic tests performed to prove compliance with specified criteria, upon completion and testing of the installed system.

2.4.2 Repair of Defects

Defects shall be repaired in accordance with approved procedures. Wherever a defect is removed and repair by welding is not required, affected area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners. After a defect is removed, and prior to making repairs, the area shall be examined by suitable methods to ensure that the defect has been eliminated. After repairs have been made, the repaired area shall be re-examined by the same methods that were originally required for the area. Any indication of a defect shall be regarded as a defect unless reevaluation by nondestructive methods and/or by surface conditioning shows that no unacceptable defect is present.

2.5 CLEANING

Submit a certified record of satisfactory cleaning of similar vessels or a record certifying not less than 2 years of experience in chemical cleaning to similar standards and for similar service. No organization performing cleaning will be considered qualified unless such proof of cleaning experience is submitted.

2.5.1 Internal Cleaning

Internal surfaces of each vessel and manifold shall be cleaned until permissible contamination limits are complied with and then shall be dried and protected. Cleaning procedures as necessary to comply with permissible contamination limits specified shall be employed. Cleaning, except during fabrication, shall be performed at place of manufacture or at installation site. Cleaning solvents that contain chlorine shall not be used on stainless steel vessels. Inspection and tests will be witnessed by the Contracting Officer at time of final acceptance.

2.5.2 Permissible Contamination Limits

Permissible contamination limits for vessels and manifolds shall not exceed the following:

- a. No hydrocarbon as evidenced by visual and ultraviolet light inspections.
- b. No solid or fibrous particle concentration greater than 5 mg/psf as measured in effluent on final rinse or 10 ppm by weight of sample.
- c. No particles greater than 150-micrometer size.
- d. No fibers greater in size than 150-micrometer diameter by 1,000-micrometer length.

2.5.3 Miscellaneous Requirements

2.5.3.1 Nominal-Rated Filters

Filters shall remove 98 percent by weight of particles whose two smallest dimensions are greater than openings in filter media. Filters made by powder metallurgy processes shall not be used.

2.5.3.2 Nitrogen

Nitrogen must have been filtered through a 40-micrometer absolute-rated filter with an element constructed of stainless steel dutch twill weave. Filter shall be cleaned so as not to contaminate the system in excess of filter rating.

2.5.3.3 Hydrocarbon

Hydrocarbon must be a combustible compound containing carbon and hydrogen.

2.5.4 Cleaning Procedures

Cleaning procedures shall be as follows, and additional procedures shall be employed as necessary to comply with the permissible contamination limits.

2.5.4.1 Cleaning During Fabrication

During vessel fabrication, surfaces and welds of vessels and manifolds which will be exposed to gas shall be thoroughly cleaned to white metal. Wire brushes used on stainless steel shall be of stainless steel. Grinding discs that have been used on carbon steel shall not be used on stainless steel vessels. Descaling may be accomplished prior to welding of final seam. When performed after cleaning, stress relieving shall be performed using an inert gas within the vessel.

2.5.4.2 After Cleaning

After cleaning, surfaces shall be treated to inhibit rust.

2.5.5 Drying

Drying of vessels shall be by heating or vacuum evacuation. Manifolds shall be dried by purge with gaseous nitrogen or dry air at a minimum of 140 degrees F. Vessels and manifolds shall be considered dry when the dew point apparatus shows that the purging medium has a dew point no higher than the dew point of influent gas which is not above minus 63.5 degrees F at one atmosphere or 26.3 ppm water vapor by volume. If vacuum evacuation is used, vessel shall be considered dry when pressure is maintained at 0.5 inch of mercury absolute for a minimum of 5 minutes at a temperature of 60 degrees F or higher temperature or at such lower pressure which is 96 percent of the vapor pressure of water for the vessel temperature. For example, for a vessel at 40 degrees F a pressure of 0.238 inch of mercury absolute shall be maintained for 5 minutes. Dry gas used for purging and drying shall be filtered through a 10-micron nominal rated filter.

2.5.6 Testing of Cleaned Vessels and Manifolds

Tests during or after cleaning shall be conducted so as not to contaminate vessels or manifolds. Should testing contaminate vessels and manifolds, recleaning shall be performed.

2.5.7 Inspection

Each vessel and manifold shall be inspected for compliance with permissible contamination limits specified herein. Certified results of such inspections shall be submitted for approval. Inspections, tests, and sampling shall be performed in the order listed below. Any vessel or manifold which is rejected in any one of these inspection procedures shall be recleaned or reworked to the extent necessary to meet requirements specified.

2.5.7.1 Inspection No. 1, Final Rinse

During final rinse and prior to drying operation, a 1-liter sample of effluent shall be examined by Millipore method or equivalent method in accordance with SAE AS598. For this purpose, rinse shall be performed using clean water and a pressure spray nozzle on interior surfaces to ensure dislodgement of particles. Effluents containing contamination in excess of permissible contamination limits shall be cause for recleaning and reinspection.

2.5.7.2 Inspection No. 2, Visual

Vessels and manifolds shall be examined for evidence of corrosion products

including rust, metal chips, scale, weld scale, oil, grease, paints, preservatives, decals, or other foreign matter. Special devices such as inspection mirrors or bore scopes shall be used to visually examine inaccessible areas of vessels or manifolds. Contamination in excess of permissible contamination limits shall be cause for recleaning and reinspection.

2.5.7.3 Inspection No. 3, Ultraviolet Light

Visual inspection with aid of an ultraviolet light shall be accomplished on accessible surfaces to determine the presence of petroleum type hydrocarbons. Wipe pads shall also be inspected by ultraviolet light. Inspectors shall be qualified to use the ultraviolet light. Contamination in excess of permissible contamination limits shall be cause for recleaning and reinspection. Ultraviolet light used for this inspection and light-intensity meter shall conform to the following:

- a. Light source shall be 100-watt spot mercury and bulb 2500 to 3700 Angstrom units.
- b. Transformer shall meet the recommendations of bulb manufacturer.
- c. Filter shall be approximately 5 inches in diameter, convex and round.
- d. Bulb shall be replaced when intensity of ultraviolet light through filter is less than 550 microwatts per square centimeter when measured 24 inches from outside surface of filter, or after 500 hours of use, whichever occurs first.

2.5.7.4 Inspection No. 4, Wipe Test

Wipe test shall be made at each end of each cleaned section of pipe and on interior surfaces of vessels and manifolds which are accessible with a probe. Clean filter paper shall be used. Interior surfaces are to be wiped on a random basis or as indicated by the results of visual inspection. Test shall consist of a linear movement of filter paper over a distance approximately 2 feet long when large areas are being tested. Smaller areas, such as manifold ends, shall receive a full circular wipe. Filter paper shall then be examined under clean-room conditions. Contamination in excess of permissible contamination limits shall be cause for recleaning and reinspection.

2.6 SEALING

2.6.1 Seals

Vessels and manifolds shall be sealed immediately after passing the cleaning inspections. Seals shall be tight enough to prevent contamination and shall be protected so that they will not be broken or warped. Tape for sealing procedures shall not leave any residue on connections when removed.

2.6.2 Flanged Openings

Flanged openings shall be sealed with a suitable full-face blank gasket 1/8 inch thick or disk at least 1/16 inch thick consisting of polytetrafluorethylene or other nonflammable, noncontaminating material and a bolted blank flange of aluminum or corrosion-resisting steel at least 1/4 inch thick. Stainless steel bolts shall be used in contact with stainless steels. Cadmium-plated bolts maybe used in contact with aluminum but shall

not be used in contact with stainless steels. A bolt correctly torqued to correspond to particular blank flange and gasket design shall be placed in each bolt hole. Gaskets and flanges shall be cleaned as specified.

2.6.3 Threaded Openings

Threaded openings shall be sealed with appropriately cleaned caps or plugs made of corrosion-resisting steel.

2.7 CERTIFICATE

Certificate of inspection indicating conformance to requirements specified shall be attached to each item. Certificate shall show the date of inspection and the signature of the Contractor's inspector.

2.8 PRESSURIZING

Vessels shall be pressurized to 15 psig with nitrogen immediately following cleaning inspections and sealing of vessels. Vessels shall be maintained at positive pressure up to and during the time of final acceptance. Vessels shall be equipped with a shutoff valve and gauge for pressurizing. The gauge shall be capable of 15 psig minimum with 1.5 psig increments between 0 to 5 psig. A protective metal cover shall be provided around the gauge and valving. Complete loss of pressure shall be cause for reinspection and recleaning as necessary to meet permissible contamination limits by and at the expense of the Contractor.

2.9 PAINTING

2.9.1 Exterior Surfaces

Exterior surfaces of all vessels, including supports but excluding stainless steel surfaces, shall be cleaned and painted in the shop. Abraded or corroded spots shall be wire brushed and touched up with the same material as the paint coat.

2.9.2 Cleaning and Preparation of Surfaces

Exterior surfaces shall be cleaned before applying paint. Oil, grease, dirt, loose dust, loose mill scale, and other foreign substances shall be removed. Removal of oil and grease shall be accomplished before mechanical cleaning is started, using mineral spirits or other paraffin-free solvents having a flash point higher than 100 degrees F. Cleaning shall be accomplished with clean cloths, fluid emulsions, steam, flame cleaning, high-speed power wire brushing, blast cleaning, or other approved methods. Use of chipping tools that produce cuts, burrs, and other forms of excessive roughness will not be permitted. Tight mill scale that cannot be removed by applying a sharp knife to any edge and minor amounts of residual rust not removable except by thorough blast cleaning will be permitted.

2.9.3 Painting of Surfaces

A primer coat of paint conforming to SSPC Paint 25 shall be applied to exterior surfaces of the vessel. Vessel shall be finished with two coats of gray enamel conforming to SSPC Paint 21. Paint shall be applied under dry and dust-free conditions when an ambient temperature is not below 40 degrees F. Painting shall be done so as to produce an even film of uniform thickness. The three-coat paint system shall be applied so that their dry film thickness at any point shall be not less than 4.0 mils, with the

primer having a minimum dry film thickness of 1.5 mils. Edges, corners, crevices, and joints shall be thoroughly cleaned and painted.

2.10 TANK BEARING PADS

The separation material for use between the propane container and the saddle of the concrete or metallic piers shall be a felt material designed to reduce the collection/retention of moisture, not less than 3/4 inch thick and not less than the width and length of the saddle. The felt shall be secured in the saddle to prevent movement while placing the tank.

2.11 METALLIC-PROTECTED FLEXIBLE CONNECTOR

A component fabricated from a flexible metallic material, listed for use with LP-Gas (propane) that provides liquid and vapor LP-Gas (propane) confinement, incorporating a metallic material over wrap that provides mechanical protection of the inner hose but does not provide fluid confinement and equipped with connections at both ends for interconnection of fixed piping to provide flexibility. Flexible Connectors shall be designed for a working pressure of at least 350 psig, with a safety factor of 5 to 1 and shall not exceed 60 inches overall length. The flexible connector shall be attached by either NPT threaded or flange connection.

Flexible connectors shall be installed where piping enters grade/pavement and or building exterior walls, and where piping exits grade/pavement. Provide an accessible control valve upstream of each connector.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Piping

All interconnecting piping shall be assembled in accordance with fabricator's drawings and instructions. All piping shall conform to the requirements of ASME B31.3. Adequately support interconnecting piping to avoid producing large stresses on the pipe or the vessel nozzles. Pipe hangers and supports shall conform to MSS SP-58. Piping supports shall allow for movement of the pipe from thermal expansion or contraction. Pipe support spacing and installation shall conform to the requirements of MSS SP-69.

3.2 FIELD TESTING

3.2.1 Testing Materials

Furnish all equipment, instruments, materials, and personnel required to perform the test. The Government will supply the utilities to perform the test such as nitrogen, and electric power.

3.2.2 Procedure

The test medium shall be clean, dry nitrogen. Piping test pressure shall be not less than 1.2 nor more than 1.5 times the design pressure. The test pressure shall be continuously maintained for a minimum of 10 minutes, and the required test procedure shall be in accordance with ASME B31.3. To pass the pressure test, the piping system shall show no evidence of leaking at all joints and connections by soap bubble or equivalent method. If system does not pass the pressure test, the problem will be corrected and

the system will be retested. Any retesting will be performed by the Contractor at the Contractor's expense. If piping test pressure is above the pressure vessel test pressure, the pressure vessel will be isolated from the piping test.

3.3 TOUCHUP PAINTING

Perform touchup painting to equipment and piping manifold as required from the inspection of the Contracting Officer. Painting materials and procedure shall conform to the requirements of paragraph PAINTING.

-- End of Section --

SECTION 33 59 00

TIGHTNESS TESTING OF EXISTING UNDERGROUND FUEL SYSTEMS
04/07

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 PETROLEUM INSTITUTE (API)

API 570 (2009, 3rd Ed) Piping Inspection Code:
In-Service Inspection, Rating, Repair, and
Alteration of Piping Systems

API RP 1110 (2013) Pressure Testing of Steel Pipelines
for the Transportation of Gas, Petroleum
Gas, Hazardous Liquids, Highly Volatile
Liquids or Carbon Dioxide

ASME INTERNATIONAL (ASME)

ASME B31.3 (2012) Process Piping

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Test Plan; G

SD-03 Product Data

Tightness Tests

SD-04 Samples

Fuel Supply

SD-06 Test Reports

Tightness Tests; G

SD-07 Certificates

Qualifications
API Inspection
Fuel Supply; G
Fuel Spills
Confirmed Leakage

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Personnel responsible for performing the tightness testing shall be trained and certified to use the test equipment needed to perform the tightness test. Each certified individual shall have a current certification number. Submit evidence of the testing personnel's experience, training, and certification to use the test equipment.

1.3.2 Regulatory Requirements

The type of tightness test to be performed shall meet applicable federal, state, and local requirements as well as the requirements within this section.

1.3.3 API Inspection

Tightness testing policies, procedures, and results shall be inspected and approved by an authorized piping inspector that is certified in accordance with API 570. Submit evidence of the inspector's experience and certification. Following testing, submit evidence of the inspector's approval of the test results.

1.4 PROJECT/SITE CONDITIONS

1.4.1 Property Damage

The Contractor is responsible for assuring that contamination and damage to tank products, the tank, and the piping does not occur from the testing procedures. If at any time any Government or private property is damaged or destroyed by any of the testing procedures or personnel, immediate notification shall be given to the Contracting Officer.

1.4.2 Fuel Supply

Fuel required for the testing of storage tanks and related piping systems as specified in this section will be provided by the Government. The Contractor shall furnish the tank trucks, operators, equipment, and services required for the fueling operations, except as modified herein. Fuel to be supplied shall meet the quality requirements as specified in paragraph "Fuels". Provide the labor, equipment, appliances, and materials required for the testing procedures. Do not test systems with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government. Record material transfers and reconcile inventory records. Submit a letter, at least 30 days prior to fuel delivery, stating the amount of fuel required for testing the system. In the submittal, define the required dates of each fuel delivery. Submit one fuel sample of each individual fuel type, prior to any tank filling process, taken from the fuel supply to be provided. The Contracting Officer may reserve the right to have the submitted samples tested by a chemical laboratory in order to verify each sample's quality. The Government will be responsible for the expense of any tests performed upon the fuel samples.

1.4.3 Fuel Spills

In the event any fuel product spill results during the testing procedures specified herein, give immediate verbal notification to the Contracting Officer. Following verbal notification, submit within 2 days a written statement that indicates the type of substance spilled, quantity, the location of the accident, the reason for spillage, a list of any cleanup procedures taken, and a list of any personnel injuries. Stop testing procedures immediately until notification is given by the Contracting Officer to begin testing again.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Test Plan

Prior to performing any site preparation work, prepare a test plan that addresses the following items for each of the storage tanks and piping systems to be tested.

3.1.1.1 Test Method

Include a complete description of the proposed tightness test method to be performed. Include equipment and step-by-step procedures required in the tightness test. Explain the accuracy involved with identifying the approximate location of a leak.

3.1.1.2 Detail Drawings/Schematics

Include detail drawings that indicate the location of the test points for each system and the points where existing piping is to be isolated. Indicate specifically how existing product pipes are to be isolated and tested. Define any demolition or alteration (permanent or temporary) to existing tanks and piping that may be required in order to perform the tightness tests.

3.1.1.3 Downtime

Indicate the maximum amount of downtime that will be required for each system to be tested. If the testing procedures can be performed while a fueling system is under operation, then the test plan shall indicate any required coordination between the testing personnel and the fueling system operators.

3.1.1.4 Site Preparation Procedures

Include a list of site preparation procedures, if applicable, to be performed by the Contractor in preparing each storage tank and piping system for testing.

3.1.2 Site Preparation

Prior to performing the tightness tests, perform the site preparation procedures as defined and approved in the test plan. Secure each testing

site with blockades and safety barriers to prevent unwanted entry. Inspect and tighten accessible fittings and equipment connections if applicable.

3.2 FIELD QUALITY CONTROL

3.2.1 Tightness Tests

Tests used on both a storage tank and piping system shall be capable of detecting a 0.1 gallon per hour leak rate with a minimum probability of detection of 0.95 and a minimum probability of false alarm of 0.05. Isolate and test each storage tank and piping system separately. Do not install permanent monitoring wells for monitoring groundwater levels. Isolate equipment such as pumps, filters, and meters from the piping system during the testing. Do not exceed the pressure rating of any component in the piping system during the testing. Submit shop drawings that show the manufacturer's brand names and catalog numbers of the testing equipment and accessories required in performing the tightness tests. The catalog data shall be in sufficient detail to demonstrate that the release detection equipment meets the specified requirements of this section.

3.2.1.1 Tank Tests

Tests shall be capable of detecting a leak from any portion of the tank that routinely contains product while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank end deflections, evaporation or condensation, temperature change, wind, vibration, noise, and the location of the water table. Acceptable tank tightness testing methods shall be either volumetric or nonvolumetric as described in this section.

a. Volumetric Testing. Tests shall be the constant-level type. Temperature sensors shall have a precision of 0.001 degrees F or less. Test methods requiring only a partially filled tank shall record data at intervals of 1 second or less. Test methods requiring a tank to be filled above the 95 percent capacity level shall record data at intervals of 5 minutes or less. Tests shall not be conducted through any type of drop tube internal to a storage tank. Tanks filled above the 95 percent level shall initially be filled to the 95 percent liquid level and allowed 24 hours to stabilize. Following the 24 hour period and if applicable, top off the tank as required and allow 3 hours to stabilize prior to testing.

b. Nonvolumetric Testing. Nonvolumetric test methods shall be capable of testing the entire volume of a tank and not just the volume containing liquid on the day of the test. Vacuum tests shall not damage the integrity of a storage tank.

3.2.1.2 Product Piping Tests

Tests shall account for temperature gains and/or losses experienced during the test period. Acceptable tightness testing methods shall be either volumetric, nonvolumetric, or hydrostatic as described in this section.

a. Volumetric Testing. Temperature sensors shall have a precision of 0.001 degrees F or less.

b. Nonvolumetric Testing. Nonvolumetric test methods shall be capable of testing the entire volume of the piping. Vacuum tests

shall not damage the integrity of the piping.

c. Hydrostatic Testing. Hydrostatically test product piping with the system's operating fuel in accordance with ASME B31.3 and API RP 1110, except as modified herein, for a minimum 8 hour period. Hydrostatically test pressurized piping systems at not less than 1-1/2 times the normal working pressure but not less than 100 psi. Use gauges for measuring the leak rate that have increments small enough to detect a leak of 0.1 gallon per hour or less. Taps for gauges or pressurizing pumps shall be on either flanged connections or on temporary piping. Do not install taps on any permanent piping. Tests shall validate that no leakage or reduction in gauge pressure occurred during the test period.

3.2.1.3 Confirmed Leakage

If a storage tank or pipe line is determined to be leaking based on the tightness tests performed, then testing shall be stopped, hydrostatic or vacuum pressures shall be relieved, the entire system shall be visually inspected, and immediate verbal notification shall be provided to the Contracting Officer. Following verbal notification, submit within 2 days a written statement that lists the possible areas where the leakage is occurring, the type of leakage (i.e. fuel or ground water), the approximate leak rate, etc. Piping systems determined to be leaking shall remain in the isolated condition unless notified otherwise by the Contracting Officer.

3.2.1.4 Testing Acceptance

A storage tank and related product lines that withstand the tightness tests performed herein shall meet the testing acceptance of this section. Do not reinstall until the entire system has passed each specified tightness test.

3.2.1.5 System Reinstallation

Following the testing acceptance of a system, thoroughly clean disconnected piping to prevent any dirt or contaminant from entering into the tank system. Reassemble the entire system to match initial conditions and to be capable of complete operation. Coordinate adjustments required to make a system operational with the Contracting Officer. Coordinate final operational testing of a system with the Contracting Officer.

3.2.2 Inspections

Prior to any final operational testing, visually inspect each tank system to assure that the system is correctly reassembled to match initial conditions. Report any component of the tank system damaged during the tightness tests immediately to the Contracting Officer. During the inspection, verify the following as a minimum:

1. The piping system is correctly connected to each storage tank.
2. The piping's protective coating was not damaged during the testing.
3. The storage tanks were not damaged during the testing.
4. Buried utility warning tape uncovered or damaged during the testing was replaced.

5. The piping's secondary containment system was not damaged during testing.

6. Each tank and pipe line cathodic protection system is connected and performing properly.

-- End of Section --