

SECTION 03 31 29

MARINE CONCRETE

08/12

PART 1 GENERAL

This section details the requirements for design, production, and placement of concrete required for this project. Three different types of concrete are required for this project:

1. Jacket Fill: Concrete fill shall be pumped using tremie methods into the FRP sheeting jacket that will be installed around the pump well. This concrete shall be MEDOT Class A with viscosity modifying admixtures to increase flow ability of the concrete.
2. Slab and Curb: Concrete for above deck slabs and curb shall be MEDOT Class A unmodified.
3. Concrete Spall and Joint Repair: Concrete for all spall and joint repairs above deck and inside the pump well shall be in accordance with Section 03 01 32 CONCRETE REHABILITATION.

Submit concrete mix designs and work plan submittals a minimum of 90 days prior to commencing concrete work. Submittals shall identify which mix each covers. Mix Designs shall include, but limited to the following: mix design proportions, material properties and test data, mix test data, admixture test data, etc.

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

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 201.2R (2008) Guide to Durable Concrete

ACI 207.1R (2005) Guide to Mass Concrete

ACI 211.1 (1991; R 2009) Standard Practice for Selecting Proportions for Normal,

Heavyweight and Mass Concrete

ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2010; Errata 2011) Specifications for Structural Concrete
ACI 301M	(2010) Metric Specifications for Structural Concrete
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 306R	(2010) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 309R	(2005) Guide for Consolidation of Concrete
ACI 311.4R	(2005) Guide for Concrete Inspection
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 WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel
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APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(2009) Structural Plywood (with Typical APA Trademarks)
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ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for
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	Concrete
ASTM A706/A706M	(2014) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A884/A884M	(2014) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M	(2013) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM C1017/C1017M	(2013) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement 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 C1202	(2012) Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1240	(2014) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C138/C138M	(2013a) 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 C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2014) 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 C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C294	(2012) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates
ASTM C295/C295M	(2012) Petrographic Examination of Aggregates for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM 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 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 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 C805/C805M	(2013a) Rebound Number of Hardened Concrete
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2014a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2013) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1179	(2010) Fluoride Ion in Water
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 D3867	(2009) Nitrite-Nitrate in Water
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D512	(2012) Chloride Ion in Water
ASTM D516	(2011) Sulfate Ion in Water
ASTM D6690	(2012) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
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
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U.S. ARMY CORPS OF ENGINEERS (USACE)

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| COE CRD-C 572 | (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops |
| COE CRD-C 61 | (1989A) Test Method for Determining the Resistance of Freshly Mixed Concrete to Washing Out in Water |

STATE OF MAINE, DEPARTMENT OF TRANSPORTATION (MEDOT)

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| MEDOT | (2014) State of Maine, Department of Transportation, Standard Specifications |
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1.2 DEFINITIONS

- a. "Cementitious material" as used herein shall include portland cement and any pozzolanic material such as fly ash, natural pozzolans, ground granulated blast-furnace slag and silica fume.
- b. "Complementary cementing materials" (CCM) 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 considerable improvement to sustainability, durability and in some cases a reduction in initial cost.
- c. "Concrete System" is the term describing a structural element comprised of concrete, reinforcing steel and concrete cover.
- d. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified by Contracting Officer to meet structural design criteria. Typical duration is 28 days; however, the Contracting Officer and Engineer of Record are encouraged to consider specifying strength at 56 or 90 days. For high-volume fly ash concrete mixtures, the duration shall be a minimum of 56 days.
- e. "Field test strength" (fcr) is the required compressive strength of concrete to meet structural and durability criteria. Determine (fcr) during mixture proportioning process.
- f. "Marine concrete" is all concrete that will be in contact with seawater or brackish water, tidal variations, splash, or spray from water in navigable waterways.
- g. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic yard or meter) of concrete.
- h. "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.
- i. "Process control sampling" is sampling and testing conducted by the Contractor to monitor the quality of materials or processes. Process control sampling is intended to indicate the quality of materials at

critical steps in production that allow intervention prior to using a material on the project.

- j. "Quality Acceptance Limit" (QAL) is the limiting value of a test result that indicates acceptable material quality. Quality acceptance limits are based on design criteria that may be either upper-bound limits where smaller values indicate acceptable material or lower-bound limits where larger values indicate acceptable material.
- k. "Quality acceptance sampling" is sampling and testing conducted by the Contractor, or an independent testing agency, to evaluate the quality of materials used on the project. Quality acceptance sampling is conducted at regular intervals identified as "lots" to represent the quality of that portion of the material used in the project.
- l. "Required compressive strength" (f'_{cr}) is the mean compressive strength of concrete required to meet structural criteria. The required strength is the mean concrete strength for tests of properly batched concrete at the age specified herein.

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

- Concrete Curing Plan; G
- Concrete Qualification Program; G
- Concrete Quality Control Program; G
- Concrete Placement and Compaction; G
- Concrete Pumping; G
- Curing concrete elements; G
- Form Removal Schedule; G
- Laboratory Qualifications; G
- Quality Control Personnel Qualifications; G

SD-02 Shop Drawings

- Construction and expansion joints; G
- Formwork
- Reinforcing steel; G
- Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Admixtures; G
Air Entraining; G
Aggregates; G
Joint filler; G
Joint sealants; G
Materials for curing concrete; G
Material Safety Data Sheets; G
Non-shrink grout; G
Reinforcing Bars; G
Reinforcement and Protective Coating; G
Reinforcement supports; G
Waterstops; G
Welded Wire Fabric; G

SD-05 Design Data

Concrete Mixture Design; G

SD-06 Test Reports

Air Entraining; G
Aggregates; G
Admixtures; G
Cement; G
Concrete Test Reports; G
Complementary Cementing Materials; G
Fresh Concrete Properties; G
Hardened Concrete Properties; G
Silica fume; G
Reinforcing Bars; G
Reinforcement and Protective Coating; G
Water; G

SD-07 Certificates

Admixtures; G

Cementitious Materials; G

Cementitious material mill certificates; G

Field testing technician and testing agency; G

SD-08 Manufacturer's Instructions

Coatings; G

SD-11 Closeout Submittals

Aggregate Moisture Content; G

Aggregate Sampling; G

Concrete Test Reports; G

Quality Control Charts; G

Daily inspection reports; G

Quality Team Meetings; G

Sampling logs; G

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with MEDOT and ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, PLACING, STORAGE, AND HANDLING OF CONCRETE

Follow ACI 301, ACI 304R, and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground and covered. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.6 CONCRETE QUALITY CONTROL

The objective of the concrete quality control program is for the Contractor to outline the procedures that will be used to construct a structure that will obtain the design service life. The Contractor shall develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan shall include approved laboratories. The Contractor shall provide direct oversight for the concrete qualification program. If concrete cylinders tested during production indicate inadequate strength, or inadequate mixing, then the owner may require the Contractor to extract concrete core samples from the hardened concrete for analysis at

Contractor's expense to assure that the quality of the concrete as placed and cured will satisfy the defined service life.

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R. Maintain a copy of ACI SP-15 and CRSI 10MSP at the project site.

1.6.1 Quality Control Personnel

The Contractor shall submit for approval an organizational chart defining the quality control hierarchy, the responsibilities of the various positions, including the names and qualifications of the individuals in those positions.

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.
- d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.
- e. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C294 and ASTM C295/C295M and trained in identification of the specific deleterious processes and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.
- f. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager Certification at the Plant Manager level.

1.6.1.1 Quality Control (QC) Manager Qualifications

The Quality Control (QC) Manager shall hold a current license as a professional engineer in a U.S. state or territory with 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 Control Manager.

1.6.1.2 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 shall be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs shall include requirements for written and performance examinations as stipulated in ACI SP-2.

- b. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329.
- c. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.

1.6.2 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory shall have the necessary equipment and experience to accomplish required testing. The laboratory shall meet the requirements of ASTM C1077, be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. The laboratories performing the tests shall be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation shall be current and shall include the required test methods, as specified.

- a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by an accredited laboratory and under the direction of a licensed/registered Civil Engineer in a U.S. state or territory, who shall 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 shall be performed by an approved, onsite, independent, accredited laboratory.

1.7 CONCRETE DURABILITY

1.7.1 Concrete Mixture Design

At least 90 days prior to concrete placement, submit concrete mixture proportions, ingredient material certificates and test data, and trial batch test data for each class of concrete proposed for use on the project. Submittal shall clearly indicate where each mixture will be used when more than one mixture design is submitted. Obtain approval from Contracting Officer prior to placement.

1.7.2 Concrete Design Requirements

1.7.2.1 General

ACI 201.2R, ACI 207.1R and ACI 211.1. All concrete mixtures shall be composed of a mixture of cement/cementitious materials, aggregate, water and chemical admixtures as required.

1.7.2.2 Concrete Types

Concrete pads and curbs: MEDOT Class A. Minimum compressive strength of

4,000 psi in accordance with ASTM C39/C39M, maximum permeability 3,000 columbs tested at 56 days in accordance with ASTM C1202, maximum w/c ratio 0.40.

Jacket Fill: MEDOT Class A Modified. Minimum compressive strength of 4,000 psi in accordance with ASTM C39/C39M, maximum permeability 3,000 columbs tested at 56 days in accordance with ASTM C1202, maximum w/c ratio 0.40. Viscosity modifying admixtures shall be used to allow for tremie placement of concrete.

Submit two concrete submittals identifying different admixtures and concrete properties.

1.7.3 Concrete Qualification Program

1.7.3.1 Fresh Concrete Properties

- a. Air Content: Concrete that is air entrained shall conform to the air limits specified in ACI 301 for exposure and the aggregate size used and tested in accordance with ASTM C231/C231M. Variations outside the limits specified shall not be reason to reject the concrete in locations not subject to freeze-thaw conditions.
- b. Slump: For all above water concrete placements the concrete mixture shall be proportioned to have, at the point of deposit, a maximum slump of 4 inches as determined by ASTM C143/C143M when admixtures that affect slump are not used. Where an ASTM C494/C494M, Type F or G admixture is used, the slump after the addition of the admixture shall not exceed 8 inches. Slump tolerances shall comply with the requirements of ACI 117.
- d. Underwater concrete: When the concrete is intended for placement under water using the tremie technique, the concrete shall be proportioned to be cohesive and flow with minimal segregation. Viscosity modifying admixtures are permitted for underwater concrete. Proportioning guidance in ACI 304R shall be considered. Provide slump and flow characteristics of concrete prior with concrete mix submittal. Concrete mixtures shall be qualified for tremie placement methods based on a trial placement approved by the Contracting Officer.

1.7.3.2 Hardened Concrete Properties

- a. Compressive Strength: The structural engineer shall specify the minimum compressive strength results at 28 days. Determine compressive strength (f'_{cr}) for qualification of concrete mixtures and for quality acceptance testing. A compressive strength test result is defined as the mean of three properly conducted tests on 4 by 8 inch cylinders in accordance with ASTM C39/C39M. Alternatively and for concrete mixtures containing a maximum size aggregate greater than 1 inch, a strength test result shall be defined as the mean of two properly conducted 28-day tests on 6 by 12 inch cylindrical specimens in accordance with ASTM C39/C39M. In addition:
 - (1) Specified Compressive Strength: For structural concrete elements exposed in a marine environment, the minimum specified 28 day design strength is denoted as (f'_c).
 - (2) Required Average Strength: The concrete shall be proportioned such that the minimum required average compressive strength (f'_{cr})

exceeds the specified design strength ($f'c$) as per ACI 301.

- (3) The average compressive strength may not exceed the specified strength at the same age by more than 20 percent unless approved by the Engineer of Record.
- (4) Strength of any individual concrete placement shall be considered satisfactory if both the following requirements are met:
 - (a) The arithmetic mean of any three consecutive lot strength tests is between 1.0 and 1.2 $f'c$; and
 - (b) No individual strength test result is less than 0.90 $f'c$.
- (5) In the event that a placement is represented by single sampling lot, strength shall be considered satisfactory if either:
 - (a) The mean of the initial test is between 1.0 and 1.2 $f'c$; or
 - (b) The mean of the initial test and retest is between 1.0 and 1.2 $f'c$, and neither strength test result is less than 0.90 $f'c$.
- (6) For underwater concrete, cast compressive strength samples by placing concrete in four 5-gallon buckets below water using similar placement as the project. Permanently mark buckets as "3 days," "7 days," "28 days," and "Extra." Include date and station. Provide specimen sets at every 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter with a minimum of one set per day of underwater concrete placement.
 - (a) Retrieve buckets at specified intervals and extract three cores from each bucket. Conduct compressive strength test in accordance with ASTM C42/C42M.
 - (b) Strength of underwater concrete shall be satisfactory if the compressive strength result from extracted cores at the age of the specified strength is between 0.85 and 1.2 $f'c$ with no individual strength test result less than 0.75 $f'c$.

1.8 CONCRETE

1.8.1 Drawings

Fabrication Drawings for concrete formwork, reinforcement materials, precast elements, wall forms, and bulkhead forms must indicate concrete pressure calculations with both live and dead loads, along with material types. Provide design calculations by a registered Civil or Structural Engineer for the formwork.

1.8.1.1 Formwork

FRP jacket shall be considered stay-in place formwork. Refer to Section 06 90 01 FIBERGLASS REINFORCED PLASTIC (FRP) SHEETING. Sheeting and wales shall be designed to support temporary construction loads and other environmental loads until such time that the concrete has reached sufficient structural strength to resist in place loads. Prior to commencing work submit drawings for approval showing details of formwork including, but not limited to: joints, supports, studding and shoring, and

sequence of form and shoring removal. Reproductions of contract drawings are unacceptable.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

ACI 347. Include design calculations indicating arrangement of forms, sizes, species, and grades of supports (lumber), panels, and related components. Indicate placement schedule, construction, and location and method of forming control joints. Include locations of inserts, pipe work, conduit, sleeves, and other embedded items. Furnish drawings and descriptions of shoring and reshoring methods proposed for slabs, beams, and other horizontal concrete members.

1.8.1.2 Reinforcing Steel

ACI SP-66. Provide bending and cutting diagrams, assembly diagrams, splicing placement 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. Only complete drawings will be accepted.

1.8.1.3 Joints

Start tremie placement with 3 to 5 foot thick plug at the bottom of the placement. Place remainder of jacket fill as monolithically as possible. Submit a plan indicating the location of each construction joint. Construction joints shall not be within 18 inches of an existing construction joint or wale. Final construction joint locations are subject to Government approval.

1.8.2 Pre-Construction Submittals

1.8.2.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.8.2.2 Concrete Curing Plan

Submit proposed materials, methods, and duration for curing and cooling concrete elements in accordance with ACI 308.1.

Minimum moist curing duration shall be seven days. Curing compound shall be used following moist cure for 14 days. Total curing period shall be 21 days.

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.

1.8.2.3 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal. Submit technical literature of forming material or liner, form release agent, form ties, and gasketing to prevent leakage at

form and construction joints. Provide a full description of materials and methods to be used to patch form-tie holes.

1.8.2.4 Concrete Placement and Compaction

- a. Submit technical literature for equipment and methods proposed for use in placing concrete. Include concrete pumping or conveying equipment including type, size and material for pipe, valve characteristics, and the maximum length and height concrete will be pumped. No adjustments shall be made to the mixture design to facilitate pumping.
- b. Submit technical literature for equipment and methods proposed for vibrating and compacting concrete. Submittal shall include technical literature describing the equipment including vibrator diameter, length, frequency, amplitude, centrifugal force, and manufacturer's description of the radius of influence under load. Where flat work is to be cast, provide similar information relative to the proposed compacting screed or other method to ensure dense placement.

1.8.2.5 Concrete Report

Provide a Report inclusive of materials and methods used, test results, and the field test strength (fcr) for concrete that shows compliance with the structural and service life requirements.

1.8.2.6 Coatings

Surface preparation and installation of any coatings on concrete shall be conducted in strict compliance with written manufacturer instructions. Submit the product data and written manufacturer instructions. A manufacturer representative shall train installers, witness initial installation, and certify that the installation was conducted in accordance with the instructions.

1.8.2.7 Preconstruction Testing of Materials

All sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.8.2.8 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.8.2.9 Mixture Designs

Provide a detailed report of materials and methods used, test results, and the field test strength (fcr) for marine concrete required to meet structural and durability requirements.

1.8.3 Sampling

The Contractor shall be responsible for conducting concrete production process control sampling and testing in compliance with this specification.

1.8.3.1 Ingredient Material Sampling

- a. Cementitious material mill certificates and test reports shall be provided for each shipment. Record the date delivered and quantity of material represented by the certificate.
- b. Conduct and log aggregate moisture content at a minimum frequency of twice daily for each day's production. Use of moisture sensors in storage bins is recommended practice, but does not satisfy this requirement.
- c. Aggregate sampling for gradation and dry-rodded unit weight shall be conducted for each 100 tons delivered for use on the project, or portion thereof.

1.8.4 Reporting

1.8.4.1 Daily Inspection Reports

Contractor shall prepare daily inspection reports for all inspection activities such as base preparation, formwork preparation, reinforcement installation, concrete placement log, and temperature control activities. Submit sample forms and describe the procedure used to organize, archive, and retrieve inspection records in the Quality Program submittal.

1.8.4.2 Sampling Logs

Contractor shall maintain a concrete placement log as an electronic spreadsheet or database identifying each placement date, placement location, volume of concrete, batch ticket numbers, lot identification code, fresh concrete properties, compressive strength results, transport properties, inspection comments, and acceptance status. Contractor shall provide/transmit the concrete testing log to the Contracting Officer weekly. The Contractor shall provide copies of supporting documents for any placement requested by the Contracting Officer immediately upon request.

1.8.4.3 Quality Control Data

The Contractor shall prepare, maintain, and report separate quality control charts illustrating the slump, temperature, air content, compressive strength test results for each lot of each concrete mixture used on the project.

1.8.4.4 Quality Team Meetings

The Contractor shall conduct regular quality control team meetings to review plans for future placements, review test results, and discuss dispensation of non-conforming materials. The quality team shall include the Contractor's Quality Control (QC) Manager, SSHO, the Project Manager, the Project Superintendent, the Contracting Officer, and representatives of the testing agency and concrete producer, or approved substitutes. It is recommended that the meetings be held on a monthly basis.

The Contractor shall prepare quality control team meeting minutes for each meeting. The minutes shall include the date of each meeting, attendees, key discussion points, findings, recommendations, assigned tasks, assigned personnel, task completion dates and status of each task.

1.8.4.5 Non-conforming materials

The exact location of non-conforming concrete as placed shall be identified and the Contracting Officer and Engineer of Record shall be notified immediately. There are numerous possible indicators that the as-placed concrete is non-conforming including, but not limited to, excessive compressive strength, inadequate compressive strength, excessive slump, transport properties out of limits, excessive voids and honeycombing, and concrete delivery records that indicate excessive time between mixing and placement and/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 to quantify the concrete properties. If justified, cores may be extracted for testing, and an investigation into the cause for non-conformance shall be conducted. The investigation may include statistical analysis of the test data collected to date; appropriateness of the pre-defined QAL based on statistical analysis of production data; the impact of the non-conforming material on the structure strength; and recommendations for concrete production process improvements, mitigation, or remediation, as appropriate.

Investigations into non-conforming materials shall be conducted at the Contractor's expense. The Contractor shall be responsible for the investigation and shall 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.

1.8.5 Test Reports

Concrete Test Reports shall be identified by a sequential report identification code. Each report shall identify the placement date, placement location, weather, name of testing technician, time of sampling, batch ticket number, fresh concrete test results, and hardened concrete test results.

1.8.5.1 Concrete Mixture Design

- a. Submit copies of test reports conforming to ASTM C1077 showing that the mixture has been successfully tested to produce concrete with the properties specified and that mixture will be suitable for the job conditions. Test reports shall be submitted along with the concrete mixture proportions. Obtain approval before concrete placement.

1.8.5.2 Complementary Cementing Materials

Submit test results in accordance with ASTM C618 and the physical and chemical analysis in accordance with applicable ASTM standards such as ASTM C311/C311M for fly ash. Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the complementary cementing materials used on the projects meets the ASTM criteria and the report on file is never older than 6 months.

1.8.5.2.1 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C989/C989M for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the report on file is never older than 6 months.

1.8.5.2.2 Ultra Fine Fly Ash or Pozzolan

Submit test results in accordance with ASTM C618 as a Class F fly ash or Class N pozzolan with the following additional requirements:

- a. The strength activity index at 28 days shall be at least 95 percent of the control.
- b. The average particle size shall not exceed 6 microns.
- c. The sum SiO_2 plus Al_2O_3 plus Fe_2O_3 shall be greater than 77 percent.

Submit test results performed within 6 months of submittal date. Update this report during construction as necessary to assure that the report on file is never older than 6 months.

1.8.5.3 Silica Fume

Submit test results in accordance with ASTM C1240 for silica fume. Data shall be based upon tests performed within 6 months of submittal. Update this report during construction as necessary to assure that the report on file is never older than 6 months.

1.8.5.4 Aggregates

Aggregate samples shall be obtained in accordance with ASTM D75/D75M and shall be representative of the materials to be used for the project. Submit test results for aggregate quality in accordance with ASTM C33/C33M, and the combined gradation curve proposed for use in the work and used in the mixture qualification, and ASTM C295/C295M for results of petrographic examination. Confirm that the potential for alkali-silica reaction are within allowable limits prescribed in this specification. Submit results of all tests during progress of the work in tabular and graphical form as noted above, describing the cumulative combined aggregate grading and the percent of the combined aggregate retained on each sieve.

1.8.5.5 Admixtures

Submit test results in accordance with ASTM C494/C494M and ASTM C1017/C1017M for concrete admixtures, ASTM C260/C260M for air-entraining admixture, and manufacturer's literature and test reports for corrosion inhibitors and anti-washout admixture. Submitted data shall be based upon tests performed within 6 months of submittal. Submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that has been subjected to freezing will be retested at the expense of the Contractor.

1.8.5.6 Portland Cement

Portland cement will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer.

Cementitious material may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed at Contractor's expense from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory. Submit test results in accordance with ASTM C150/C150M portland cement and/or ASTM C595/C595M and ASTM C1157/C1157M for blended cement.

1.8.5.7 Testing During Construction

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.8.5.8 Acceptability of Work

The materials and the structure itself will be accepted on the basis of tests made by the Contractor and shall be in compliance with the criteria herein. The Government may make check tests at its expense to validate the results of the Contractor's testing. Testing performed by the Government will in no way relieve the Contractor from the specified testing requirements.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement or cement blended with complementary cementing materials. New submittals are required when the cementitious materials change sources or types.

The Contractor shall provide cementitious materials meeting the requirements of the applicable specification, and as modified herein. Provide mill certificates and test results conducted within six-months of the submittal date as part of the concrete mixture qualification submittal.

Provide a single manufacturer of cementitious material for each type of cement and complementary cementing materials supplied to the project.

2.1.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type I/II, low alkali 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. Low alkali cement may be required if the proposed aggregates are found to be expansive.

ASTM C150/C150M cements shall be combined with complementary cementing materials in the concrete mixture.

2.1.2 Blended Cements

Blended cement shall conform to ASTM C595/C595M, 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 shall be ASTM C989/C989M ground granulated blast-furnace slag. The pozzolan added to the Type IP blend shall be ASTM C618 Class F and shall be interground with the cement clinker. The manufacturer shall 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 shall not change from that submitted for the aggregate evaluation and mixture proportioning.

2.1.3 Pozzolan

2.1.3.1 Fly Ash

Fly ash shall conform to ASTM C618, Class F, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall 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.

2.1.3.2 Raw or Calcined Natural Pozzolan

Natural pozzolan shall 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 shall have an on ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

2.1.3.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.
- b. The average particle size shall not exceed 6 microns.
- c. The sum of $SiO_2 + Al_2O_3 + Fe_2O_3$ shall be greater than 77 percent.

2.1.4 Ground Granulated Blast-Furnace (GGBF) Slag

Ground Granulated Blast-Furnace Slag shall conform to ASTM C989/C989M, Grade 100 or Grade 120. Add with cement.

2.1.5 Silica Fume

Silica fume shall conform to ASTM C1240, including the optional limits on

reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. A High Range Water Reducer (HRWR) shall be used with silica fume. Finishing may be more difficult. Proper curing is essential because there is a tendency for plastic shrinkage cracking.

2.1.6 Complementary Cementing Materials (AKA Supplementary Cementitious Materials (SCM) Content (SCM))

The concrete mix shall always contain complementary cementing materials whether or not the aggregates are found to be reactive in accordance with the subpart entitled "Aggregates". Concrete mixtures shall be designed and proportioned to meet the requirements for strength, constructability, shrinkage, and service life.

2.2 AGGREGATES

Comply with ASTM C33/C33M Class 4S, except as modified herein.

The quantities to be retained on each sieve may be adjusted only where available aggregates are elongated or slivered and cause interference with mix mobility, or available aggregate gradations do not comply with the 18-8 requirement. When necessary to satisfy local conditions and when permitted, the combined aggregate percentages may be changed to not more than 22 percent nor less than 6 percent retained on any individual sieve. The combined aggregates in the mixture (coarse, intermediate, and fine) shall be well graded with no more than 18 percent nor less than 8 percent of the combined aggregate retained on any individual sieve, unless satisfactory performance can be demonstrated. The No. 50 sieve may have less than 8 percent retained; sieves finer than No. 50 shall have less than 8 percent retained, and the coarsest sieve may have less than 8 percent retained. Use intermediate sizes for blending where necessary, to provide a well graded combined aggregate.

- a. Provide gradation of individual aggregate sizes using standard concrete aggregate sieves including 1-1/2 inches, one inch, 3/4 inch, 1/2 inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, No. 50, and No. 100.
- b. Provide aggregates for exposed concrete from one source. Aggregate reactivity shall be limited per the subpart entitled "Aggregates". Provide aggregate containing no deleterious material properties as identified by ASTM C295/C295M.
- c. Where a size designation is indicated, that designation indicates the nominal maximum size of the coarse aggregate.
- d. Aggregate tests shall be conducted within 6 months from the date of concrete mixture submittal.
- e. Provide ASTM C1260 or ASTM C1567 test results conducted with 6 months of the submittal date showing the proposed coarse and fine aggregates

are either: innocuous to alkali silica reaction; or that reactivity has been mitigated by the proposed cementitious materials as modified herein. Conduct ASTM C1260 tests on each aggregate source separately. Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested. Test results of the individual aggregates shall have a measured expansion equal to or less than 0.08 percent after 28 days of immersion in a 1M NaOH solution at 176 degrees.

- f. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected or additional testing shall be performed as follows: utilize the Contractor's proposed low alkali portland cement, blended cement, and/or complementary cementing materials, in combination with each individual aggregate. If SCMs are being evaluated, the testing shall be in accordance with ASTM C1567. Determine the quantity that will meet all the requirements of these specifications and that will lower the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity.

2.3 WATER

Water shall comply with the requirements of ASTM C94/C94M and ASTM C1602/C1602M, except that the chloride and sulfate limits as tested in accordance with ASTM D512 and ASTM D516 shall not exceed 500 parts per million chloride ion and not more than 1000 parts per million of sulfate ion as SO4. Water shall be free from injurious amounts of oils, acids, alkalis, salts, and organic materials. Where non-potable water or water from reprocessed concrete is proposed for use in the work, submit results of tests in accordance with ASTM C1602/C1602M. Submit test results in accordance with ASTM D512 and ASTM D516.

2.4 ADMIXTURES

- a. Provide certifications that chemical admixtures comply with the requirements shown in Table 5 and are compatible with each other. Use admixtures in accordance with manufacturer's recommendations, as appropriate for the climatic conditions and construction needs.
- b. Do not use calcium chloride or admixtures containing chloride ion content in more than trace amounts from impurities in admixture ingredients or potable water. Provide maximum concentrations of corrosion-inducing chemicals as shown in Table 1. For concrete that may be in contact with prestressing steel tendons, the concentration shall not exceed 60 percent of the limits given in Table 1. For the concentration in grout for prestressing ducts, do not exceed 25 percent of the limits in Table 1.

Chemical*	Limits, Percent**	Test Method
Chlorides	0.10	ASTM D512

Table 1 - Limits on Corrosion-Inducing Chemicals		
Chemical*	Limits, Percent**	Test Method
Fluorides	0.10	ASTM D1179
Nitrates	0.17	ASTM D3867
* Limits refer to water-soluble chemicals		
** Limits are expressed as a percentage of the mass of the total cementitious materials.		

- c. Provide anti-washout or viscosity modifying admixtures for underwater concrete placement. Provide certification that the admixture is compatible with the cementitious materials and other chemical admixtures in the proposed concrete mixture. The anti-washout or viscosity modifying admixture shall require approval by the Contracting Officer and have a proven record of performance with a minimum of five similar projects. Test per COE CRD-C 61 to determine cumulative mass loss shall be performed once for each 350 cubic yards of underwater concrete and results submitted to Contracting Officer for approval prior to continued use.
- d. The total alkali contribution of chemical admixtures shall not increase the total sodium-oxide equivalent content of the concrete mixture by more than 0.5 lb/yd³.

2.4.1 Air Entraining

Provide air entraining admixtures conforming to ASTM C260/C260M

2.4.2 Accelerating

ASTM C494/C494M, Type C.

2.4.3 Retarding

ASTM C494/C494M, Type B, D, or G.

2.4.4 Water Reducing

ASTM C494/C494M, Type A, E, or F.

High Range Water Reducer (HRWR) shall be ASTM C494/C494M, Type F and ASTM C1017/C1017M.

2.5 NON-SHRINK GROUT

ASTM C1107/C1107M.

2.6 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects.

Plywood: APA PS 1, B-B concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.

2.6.1 Form Ties and Form-Facing Material

- a. 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 shall not reduce the effective cover of the reinforcement.
- b. Form-facing material shall be structural plywood or other material that can absorb air and some of the high water-cementitious materials ratio surface paste that may be trapped in pockets between the form and the concrete. Maximum reuse is three times. Provide forms with a form treatment to prevent bond of the concrete to the forms. Use a controlled permeability form liner in strict accordance with the manufacturer's recommendations.

2.7 REINFORCEMENT

2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified and shall meet the design yield strength and ductility requirements. Deformed reinforcing bars meeting the requirements of ASTM A706/A706M with the bars marked A; ASTM A767/A767M Class 1 galvanized; prefabricated epoxy coated, ASTM A934/A934M; or other approved reinforcing material shall be permitted for use in the cast-in-place concrete system. Epoxy coated reinforcing steel shall be used in above concrete slab and curb placements. Uncoated reinforcing steel shall be used for spall and deck joint repairs only.

The reinforcing selected shall match the structural properties of the reinforcing specified. Alternative reinforcing bars shall have similar structural properties to the specified reinforcing and may be used with the Contracting Officers approval.

2.7.1.1 Reinforcement and Protective Coating

Provide coating manufacturer's and coating applicator's test data sheets certifying that applied coating meets the requirements of the concrete system.

2.7.2 Welded Wire Fabric

Comply with ASTM A1064/A1064M carbon steel. Provide flat sheets of welded wire fabric for slabs and toppings. Epoxy coated welded wire fabric shall be used for concrete fill. Coating shall be in accordance with ASTM A884/A884M

2.8 ACCESSORY MATERIALS

2.8.1 Polyvinylchloride Waterstops

Polyvinylchloride water stops shall be used for the upper horizontal joint in the concrete placement around the exterior of the pump well. COE CRD-C 572. MEDOT Type D for horizontal joint at EL 3.0 FT as indicated.

2.8.2 Hydrophilic Waterstop

Hydrophilic Waterstops shall be used for sluice gate work as indicated. Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.8.3 Materials for Curing Concrete

2.8.3.1 Impervious Sheeting

ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.8.3.2 Pervious Sheeting

AASHTO M 182 or carpet covering the free surface and kept continuously wet throughout the curing period.

2.8.3.3 Liquid Membrane-Forming Compound

Comply with ASTM C309, white-pigmented, Type 2, Class B.

2.8.4 Expansion/Contraction Joint Filler

Comply with ASTM D1751 or ASTM D1752, 1/2 inch thick unless otherwise indicated.

2.8.5 Joint Sealants

2.8.5.1 Horizontal Surfaces

Horizontal surfaces are defined as all surfaces with a 3 percent maximum slope. ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

PART 3 EXECUTION

3.1 CONCRETE SURFACE PREPARATION

High-pressure water blast, minimum 10,000 psi shall be required on all exterior concrete surfaces prior to placements. Water blast shall remove all marine growth. Water blast on surfaces exposed to the river shall be completed within 21 days of concrete placement to limit regrowth. Provide details on equipment and procedures in concrete work plan.

3.2 FORMS

- a. Provide formwork with clean-out openings to permit inspection and removal of debris. Formwork shall be gasketed or otherwise rendered sufficiently tight to prevent leakage of paste or grout under heavy, high-frequency vibration. Use a release agent that does not cause surface dusting. Limit reuse of plywood to no more than three times. Reuse may be further limited by the Contracting Officer if it is found that the pores of the plywood are clogged with paste so that the wood does not absorb air and some of the high water-cementitious materials ratio paste that may be trapped in pockets between the form and the

concrete.

- b. Comply with ACI 301. Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width shall be a minimum of 4 inches greater than indicated. Set forms rigidly, 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. Forms submerged in water shall be watertight.
- c. Patch form tie holes with a no shrink patching material in accordance with the manufacturer's recommendations and subject to approval.

3.2.1 Coating

Before concrete placement, coat the contact surfaces of forms with a no staining mineral oil, no staining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied. Do not use any coating on FRP forms.

3.2.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347, except for concrete placed underwater, forms shall remain in place a minimum of 48 hours. Prevent concrete damage during form removal. FRP forms are permanent and shall not be removed.

3.2.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C39/C39M test results of field-cured samples from a representative portion of the structure or other approved and calibrated non-destructive testing techniques show that the concrete has reached a minimum of 85 percent of the design strength.

3.2.3 Reshoring

Do not allow construction loads to exceed the superimposed load which the structural member, with necessary supplemental support, is capable of carrying safely and without damage. Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with subpart entitled "Removal of Forms and Supports." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carry capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Remove rust, scale, oil, grease, clay, or foreign substances from reinforcing that would reduce the epoxy coating bond from reinforcing. Do not tack weld. Inspect and verify proper reinforcement grade, quantity, spacing, and clearance requirements prior to concrete

placement. Inspect placed steel reinforcing for coating damage prior to placing concrete. Repair all visible damage.

3.3.1 Coated Reinforcing

Record coating lot on each shipping notice and carefully identify and retag bar bundles from bending plant. Provide systems for handling coated bars which have padded contact areas, nylon slings, etc., to keep bars free of dirt and grit. Carefully handle and install bars to minimize job site patching including lifting and supporting bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. When possible, assemble reinforcement as tied cages prior to final placement into the forms. Bundling bands shall be padded where in contact with bars. Do not drop or drag bars or bundles. Store coated bars both in shop and in field, aboveground, on wooden or padded cribbing with adequate protective blocking between layers. Schedule deliveries of coated bars to the job site to avoid the need for long term storage. Protect from direct sunlight and weather. Bars to be stored longer than 12 hours at the job site shall be covered with opaque polyethylene sheeting or other suitable equivalent protective material. Inspect for defects and provide required repairs prior to assembly. After assembly, reinspect and provide final repairs. Excessive nicks and scrapes which expose steel shall be cause for rejection.

- a. Immediately prior to application of the patching material, any rust and debonded coating shall be manually removed from the reinforcement by suitable techniques employing devices such as wire brushes and emery paper. Care shall be exercised during this surface preparation so that the damaged areas are not enlarged more than necessary to accomplish the repair. Damaged areas shall be clean of dirt, debris, oil, and similar materials prior to application of the patching material.
- b. Repair and patching shall be done in accordance with the patching material manufacturer's recommendations. These recommendations, including cure times, shall be available at the job site at all times.
- c. Allow adequate time for the patching materials to cure in accordance with the manufacturer's recommendation prior to concrete placement.
- d. Rinse placed reinforcing bars with ASTM C1602/C1602M compliant water to remove chloride contamination prior to placing concrete.

3.3.2 Reinforcement Supports

Place reinforcement and secure with non-corrodible chairs, spacers, and hangers. Metal hangers may be used, but shall be of similar material to the reinforcing. Support reinforcement on the ground with concrete or other non-corrodible material, having a compressive strength equal to or greater than the concrete being placed and having permeability equal or less than the concrete being placed.

Coated reinforcing bars supported from formwork shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable material. Wire bar supports shall be coated with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the coated reinforcing bars. Reinforcing bars used as support bars shall be coated with the same material as the reinforcing. Spreader bars, where used, shall be coated. Non-coated

combination bar clips and spreaders used in construction with coated reinforcing bars shall be made corrosion resistant or coated with dielectric material. Coated bars shall be tied with plastic-coated tie wire; or other materials acceptable to the Contracting Officer.

3.3.3 Splicing

As indicated. For splices not indicated, comply with ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. Welded splices shall comply with AWS D1.4/D1.4M and be approved prior to use.

3.3.4 Cover

As noted on drawings. Comply with ACI 318 for concrete cover over the steel reinforcement. Use ACI 117 to determine allowable tolerances for the placement of the steel.

3.3.5 Setting Miscellaneous Material and Prestress Anchorages

Place and secure anchors, bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete. Electrically isolate exposed steel work and its anchor systems from the primary steel reinforcement with at least 2 inches of concrete. Coat exposed steel work to reduce corrosion. Take particular care to ensure against corrosion on edges and horizontal surfaces. Use epoxy coatings for protection of carbon steel plates and fittings.

3.3.6 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated. Final joint locations are subject to Government approval or substantiating calculations from the Contractor.

3.3.7 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Place contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.3.8 Waterstop Splices

Fusion weld in the field.

3.3.9 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.4 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, ACI 301, and ACI 304R, except as modified herein. Batching equipment shall 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 tickets imprinted with mix identification, batch size, batch design and measured weights, moisture in the aggregates, and time batched for each load of ready mix concrete. When a pozzolan is batched cumulatively with the cement, it shall be batched after the cement has entered the weight hopper.

3.4.1 Measuring

Make measurements at intervals as specified in subpart entitled "FIELD QUALITY CONTROL".

Adjust batch proportions to replicate the mixture design using methods provided in the approved quality assurance plan. Base the adjustments on results of tests of materials at the batch plant for use in the work. Maintain a full record of adjustments and the basis for each.

3.4.2 Mixing

Comply with ASTM C94/C94M and ACI 301. If time of discharge exceeds time required by ASTM C94/C94M, submit a request along with description of precautions to be taken.

3.4.3 Transporting

Comply with ACI 304R.

3.5 PLACING CONCRETE

Comply with ACI 304R and ACI 304.2R. Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other or lifts for vertical construction. Limit concrete placements for fill to three as defined by drawings.

3.5.1 Vibration

Comply with the requirements of ACI 309R and ASTM A934/A934M for epoxy-coated bar using vibrators with a minimum frequency of 9,000 vibrations per minute (VPM). Use only high cycle or high frequency vibrators. Motor-in-head 60 cycle vibrators may not be used. For walls and deep beams, use a minimum of two vibrators with the first to melt down the mixture and the second to thoroughly consolidate the mass. Provide a spare vibrator at the casting site whenever concrete is placed. Place concrete in 18 inch maximum vertical lifts. Insert and withdraw vibrators approximately 18 inches apart. Penetrate at least 8 inches into the previously placed lift with the vibrator when more than one lift is required. Extract the vibrator using a series of up and down motions to

drive the trapped air out of the concrete and from between the concrete and the forms.

For slab construction use vibrating screeds designed to consolidate the full depth of the concrete. Where beams and slabs intersect, use an internal vibrator to consolidate the beam. Do not vibrate concrete placed with anti-washout admixtures. Vibrators shall be equipped with rubber vibrator heads.

3.5.2 Cold Weather

Comply with ACI 306R. Provide provisions for cold weather concrete work in concrete placement plan submittal. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Placement of concrete shall be halted whenever the ambient temperature drops below 40 degrees F. When the ambient temperature is less than 50 degrees F the temperature of the concrete when placed shall be not less than 50 degrees F or more than 75 degrees F. Heating of the mixing water or aggregates may be necessary to regulate the concrete placing temperature. An accelerating admixture may be used when the ambient temperature is below 50 degrees F. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 7 days after placing, and at a temperature above freezing for the remainder of the curing period.

3.5.3 Hot Weather

Comply with ACI 305R. Provide provisions for hot weather concrete work in concrete placement plan submittal. Maintain required concrete temperature using Figure 2.1.5, "Effect of Concrete Temperatures, Relative Humidity, and Wind Velocity on the Rate of Evaporation of Surface Moisture From Concrete" in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. If necessary, 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. If the evaporation rate exceeds 0.1 pound of water per square foot per hour, fog spray the exposed concrete surfaces until active moist curing is applied. 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.

3.5.4 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Figure 2.1.5 of ACI 305R. In addition to the protective measures concrete placement shall be further

protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. When such water treatment is stopped, curing procedures shall be immediately commenced. The methods and materials to remove or repair areas affected by plastic shrinkage cracks shall be suggested by the Contractor and approved by the Contracting Officer. Cracks shall never be troweled over or filled with cement slurry.

3.5.5 Depositing Concrete Under Water

ACI 301 methods and equipment used shall prevent the washing of the cement from the mixture, minimize the formation of laitance, prevent the flow of water through the concrete before it has hardened, and minimize disturbance to the previously placed concrete. Tremies shall be watertight and sufficiently large to permit a free flow of concrete. Keep the discharge end continuously submerged in fresh concrete. Keep the shaft full of concrete to a level well above the water surface. Discharge and spread the concrete by raising the tremie to maintain a uniform flow.

Contractor shall place concrete as monolithically as possible. Place concrete without interruption until the top of the fresh concrete is at the required height. Do not physically move concrete horizontally. If modifications are required to the locations of the concrete core holes submit modifications or additional core holes for approval.

3.6 SURFACE FINISHES EXCEPT HORIZONTAL CONCRETE JACKET

3.6.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than one square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with non-shrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise indicated.

3.6.2 Formed Surfaces

3.6.2.1 Tolerances

Comply with ACI 117 and as indicated.

3.6.2.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.6.2.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary

to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Patch tie holes and defects and completely remove fins.

3.7 FINISHES FOR HORIZONTAL CONCRETE JACKET

3.7.1 Finish

Comply with ACI 301. 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 excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.7.1.1 Floated

Exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation.

3.7.1.2 Broomed

Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab. Broom finish all top of deck repair areas and construction joint repairs.

3.8 CURING AND PROTECTION

Comply with ACI 301 and ACI 308.1 unless otherwise specified. Prevent concrete from drying by misting surface of concrete. Begin curing immediately following final set. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, by rain or running water, adverse weather conditions, 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.

Furnish ASTM C39/C39M test results to verify the anticipated rate of strength development for the proposed concrete design mixture. Submit an increased curing period and minimum time to strip formwork based upon the reduced rate of strength development.

3.8.1 Wet Curing

Wet cure marine concrete using ASTM C1602/C1602M compliant water for a minimum of 7 days. Do not allow construction loads to exceed the superimposed load which the structural member, with necessary supplemental support, is capable of carrying in current condition safely and without damage.

Leaving the forms in place for seven days is a suitable alternative to wet curing.

3.8.1.1 Ponding or Immersion

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

3.8.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.8.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete or over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.8.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.8.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5, "effect of Concrete Temperatures, Relative Humidity, and Wind Velocity on the Rate of Evaporation of Surface Moisture From Concrete" in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pounds of water per square foot per hour.

3.8.2.1 Application

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

3.8.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.8.3 Curing Periods

Moist cure concrete using ASTM C1602/C1602M compliant water for a minimum of 7 days. Continue additional curing with use of curing compound for a total period of 21 days. 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 shall be subject to approval by the Contracting Officer.

3.9 FIELD QUALITY CONTROL

3.9.1 Fresh Concrete Properties

For each concrete mixture, the Contractor shall take samples in accordance with ASTM C172/C172M, test and record the slump, and temperature. If the slump deviates from the previous batch by more than 1 inch, air content shall also be determined. Adjustment of air content and/or slump with chemical admixture is permitted provided the water to cementitious material ratio is not exceeded.

3.9.1.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved high range water reducing (HRWR) admixture provided that the water-cementitious ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 50 cubic yards (maximum) of concrete. If concrete does not pass slump test, adjust using a HRWR and test every concrete batch until two (2) consecutive batches meet slump without adjustment.

3.9.1.2 Temperature Tests

- a. 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 50 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

- b. Determine temperature of each concrete sample in accordance with ASTM C1064/C1064M. Temperatures must comply with the Concrete Temperature Control Plans.

3.9.1.3 Air Content Tests

ASTM C231/C231M or ASTM C173/C173M. Perform tests at commencement of concrete placement each day, when test cylinders are made, and if slump test varies by more than 1 inch from previous results or concrete does not pass slump test.

3.9.1.4 Unit Weight Test

ASTM C138/C138M. Take concrete samples during concrete placement. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 50 cubic yards (maximum) of concrete.

3.9.2 Hardened Concrete Properties

Sample and test each lot onced placed.

Cast and cure specimens in accordance with ASTM C172/C172M, ASTM C31/C31M, and applicable requirements of ACI 305R and ACI 306R.

For each lot, record the date and time sampled, the batch ticket code, cylinder ID code the location of placement, total volume of concrete represented by the sample, and fresh concrete properties; ASTM C143/C143M for slump or ASTM C1611/C1611M for slump flow and visual stability index (VSI), ASTM C231/C231M for air content, ASTM C1064/C1064M for temperature, and ASTM C138/C138M unit weight.

For each lot sample, cast twelve 6 by 12 inch cylinder specimens for strength and seven 4 by 8 inch cylinder specimens for transport property testing. Special handling will be necessary for shipments of transport property specimens. These cylinders shall be wrapped completely with slightly dampened paper towels with spring water only. The wrapped cylinders shall be placed in either a vacuum package or double layers of sealed plastic bags. Package cylinders to prevent damage and ship priority mail to the approved testing laboratory.

In the event the results of cylinder tests fail to satisfy transport properties, then an additional pair of specimens shall be tested. In the event quality acceptance test results and retest results fail to meet the quality acceptance criteria, the entire lot shall be considered non-conforming material, refer to the subpart entitled "REPAIR, REHABILITATION AND REMOVAL".

3.9.2.1 Compressive Strength Tests

ACI 214R tests for strength - conduct strength tests of concrete during construction in accordance with the following procedures:

- a. Test cylinders in accordance with ASTM C39/C39M. Test three cylinders at 3 days, three cylinders at 7 days, and three cylinders at the age when the compressive strength requirement was specified. Hold the remaining three cylinders in storage. If one specimen in a test shows evidence of improper sampling, molding or testing, discard the specimen and consider the strength of the remaining cylinder to be the

test result. If more than one specimen shows excess defects, the Contracting Officer may allow the entire test to be discarded. Test results shall not exceed the specified compressive strength by more than 20 percent for the age specified.

- b. If the average strength test results are less than the specified strength (f'c) extract three core samples from the structure in accordance with ASTM C42/C42M, from the area that correlates to the low test results. These extracted cores shall not contain steel reinforcing. Repair core holes with non-shrink grout. Match color and finish of adjacent concrete. For concrete not meeting strength criteria the Contractor shall prepare a remediation strategy for the review by the Contracting Officer.
- c. Strength test reports shall be provided within 7 days of test completion.

3.9.2.2 Anti-Washout Admixture

Comply with COE CRD-C 61. Determine cumulative mass loss. Perform test once for each 350 cubic yards of underwater concrete.

3.9.2.3 Non-Destructive Tests

Use of a rebound hammer to obtain data on the strength of the concrete surface shall be in accordance with ASTM C805/C805M. Test results from the rebound hammer and other non-destructive testing may be helpful in selecting areas to extract concrete cores for destructive testing.

3.9.3 Core Samples and Compressive Strength Testing

Obtain and test cores in accordance with ASTM C42/C42M.

If concrete in the structure is dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before testing and test dry. Otherwise, test the cores, after moisture conditioning, in accordance with ASTM C42/C42M.

Acceptance criteria for cylinder compressive strength are provided in subpart entitled "Acceptance of Concrete Strength".

Take at least three representative cores from each member or area of concrete in place that is considered potentially strength deficient. Impair the strength of the structure as little as possible. If, before testing, extracted cores show evidence of having been damaged subsequent to or during removal from the structure, take replacement cores.

Fill core holes with a dry pack mix of a strength equal to or greater than the original concrete.

The Contracting Officer will evaluate and validate core tests in accordance with the specified procedures.

3.9.4 Acceptance of Concrete Strength

3.9.4.1 Standard Molded and Cured Strength Specimens

The acceptance of concrete strengths shall be based on averages of results from three consecutive compressive strength tests. When the averages of

all sets of three consecutive compressive strength test results are between 1.0 and 1.2 times the field test strength (fcr), and no individual strength test falls below fcr by more than 500 psi, the strength of the concrete is satisfactory. These criteria also apply when accelerated strength testing is specified unless another basis for acceptance is specified.

3.9.4.2 Non-Destructive Tests

Non-destructive tests may be used when permitted to evaluate concrete where standard molded and cured cylinders have yielded results not meeting the criteria.

3.9.4.3 Extracted Core Tests

When the average compressive strengths of the representative cores are between 0.85 fcr and 1.2 fcr and if no single core is less than 0.75 fcr, the strength of concrete is satisfactory.

3.9.5 Inspection

ACI 311.4R. Inspect concrete placed under water with qualified divers.

3.10 REPAIR, REHABILITATION AND REMOVAL

Before the Government accepts the structure and final payment is made, the Contractor shall 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 shall be prepared which includes recommendations for repair, removal and/or remediation which, shall be submitted to the Contracting Officer for approval before any corrective work is accomplished.

3.10.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.007 inches wide shall be documented and repaired. The proposed method and materials to repair the cracks shall be submitted to the Contracting Officer for approval. The proposal shall address the amount of movement expected in the crack due to temperature changes and loading.

3.10.2 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 shall be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick shall be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.10.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor to restore the service life shall be approved by the Contracting Officer prior to proceeding.

-- End of Section --

SECTION 04 20 00

MASONRY
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.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 530/530.1 (2013) Building Code Requirements and Specification for Masonry Structures and Related Commentaries

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M (2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM A153/A153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A615/A615M (2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM B633 (2013) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

ASTM C1019 (2013) Standard Test Method for Sampling and Testing Grout

ASTM C1072 (2013; E 2014) Standard Test Method for Measurement of Masonry Flexural Bond Strength

ASTM C1142 (1995; R 2013) Standard Specification for Extended Life Mortar for Unit Masonry

ASTM C129 (2011) Standard Specification for Nonloadbearing Concrete Masonry Units

ASTM C144 (2011) Standard Specification for Aggregate for Masonry Mortar

ASTM C150/C150M (2012) Standard Specification for Portland Cement

ASTM C207	(2006; R 2011) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2012a) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2010) Standard Specification for Grout for Masonry
ASTM C55	(2011) Concrete Brick
ASTM C641	(2009) Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2014) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C90	(2014) Loadbearing Concrete Masonry Units
ASTM C91/C91M	(2012) Standard Specification for Masonry Cement
ASTM C94/C94M	(2014a) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2013) Standard Specification for Slag Cement for Use in Concrete and Mortars

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

Cement; G

SD-04 Samples

Concrete Masonry Units (CMU); G
Concrete Brick; G
Bar Positioners; G
Horizontal Joint Reinforcement; G

SD-05 Design Data

Pre-mixed Mortar; G

SD-06 Test Reports

Field Testing of Mortar; G
Field Testing of Grout; G
Masonry Cement; G

SD-07 Certificates

Concrete Brick
Concrete Masonry Units (CMU)
Bar Positioners
Masonry Cement

SD-08 Manufacturer's Instructions

Masonry Cement

1.3 QUALITY ASSURANCE

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, stored, handled, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C90.

1.4.2 Reinforcement

Steel reinforcing bars and joint reinforcement shall be stored above the ground. Steel reinforcing bars shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination or segregation.

1.5 PROJECT/SITE CONDITIONS

Materials used in masonry construction shall be assimilated to interior ambient conditions for at least 48 hours prior to installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2 CONCRETE BRICK

Concrete brick shall conform to ASTM C55, Grade N. Concrete brick may be

used where necessary for filling out in concrete masonry unit construction. Submit samples as specified.

2.3 CONCRETE MASONRY UNITS (CMU)

Submit samples and certificates as specified. Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture. Submit samples.

- a. Hollow Non-Load-Bearing Units: ASTM C129, made with lightweight aggregate.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification. Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates. Slag shall comply with ASTM C989/C989M; Grade 100.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces shall have a uniform fine to medium texture and a uniform color.

2.4 MASONRY MORTAR

Mortar Type N. Conform to the proportion specification of ASTM C270. Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. When masonry cement ASTM C91/C91M is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C780 and ASTM C1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.4.1 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C207, Type S.

2.4.2 Cement

Portland cement shall conform to ASTM C150/C150M, Type I, II, or III. Masonry cement shall conform to ASTM C91/C91M, Type N. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume. When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required. Additives shall

conform to requirements in Section 03 31 29 MARINE CONCRETE.

2.4.3 Pre-Mixed Mortar

Pre-mixed mortar may be used in lieu of Type N and shall conform to ASTM C1142, Type RN. Submit pre-mixed mortar composition.

2.4.4 Sand and Water

Sand shall conform to ASTM C144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.5 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C1019. Use grout subject to the limitations of Table III. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C94/C94M.

2.5.1 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.6 BAR POSITIONERS

2.6.1 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell. Telescoping bar positioner shall be manufactured from AISI 1065 spring steel and coated in accordance with ASTM B633. Submit samples.

2.7 HORIZONTAL JOINT REINFORCEMENT

Horizontal joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A1064/A1064M, welded construction. Wire shall have zinc coating conforming to ASTM A153/A153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units. Joint reinforcement shall be placed with a minimum of 5/8 inch cover from each face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.8 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A615/A615M, Grade 60.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls and floors from splash stains by covering with polyethylene.

3.1.2 Surfaces

Clean surfaces on which masonry is to be placed of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Each unit shall be adjusted to its final position while mortar is still soft and plastic.
- b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.
- c. Units being laid and surfaces to receive units shall be free of water film. Vertical joints of the vertical face shells of concrete masonry units shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

3.2.1 Reinforced Concrete Masonry Units Walls

Fill cores solid with grout as indicated. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing using bar positioners before placing grout. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch.

3.2.2 Concrete Masonry Units

Units in lintels and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Jamb units shall be of the

shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, and elsewhere as approved.

3.2.3 Tolerances

Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Square corners unless noted otherwise. Lay masonry within the following tolerances (plus or minus unless otherwise noted):

TABLE I TOLERANCES	
Variation from the plumb in the lines and surfaces of walls	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
Variations from the plumb for external corners, and other conspicuous lines	
In 20 feet	1/4 inch
Variations from the level for exposed lintels, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
Variations in cross sectional dimensions in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.4 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, and other wall

penetrations, unless steel sleeves are used.

3.2.5 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove loose and excess mortar. Mortar joints shall be finished as follows:

3.2.5.1 Tooled Joints

Joints in exposed masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.6 Joint Widths

Joint widths shall be as follows:

3.2.6.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.7 Embedded Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, accessories, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors and joint reinforcement in the mortar.

3.2.8 Unfinished Work

Step back unfinished work for joining with new work. Tothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.2.9 Masonry Wall Intersections

Masonry bond each course at corners. Masonry walls shall be tied together at corners with prefabricated corner pieces of joint reinforcement.

3.2.10 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck. A compressible joint shall be placed between partitions and the existing concrete beams or slabs.

3.3 MORTAR MIX

Mix mortar in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measure ingredients for mortar by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Mix water with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Retemper mortar that has stiffened because of loss of water through evaporation by adding water to restore

the proper consistency and workability. Discard mortar that has reached its initial set or that has not been used within 2.5 hours after mixing.

3.4 REINFORCING STEEL

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.4.1 Positioning Bars

Vertical bars shall be accurately placed within the cells using bar positioners. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.

3.4.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement.

3.5 HORIZONTAL JOINT REINFORCEMENT INSTALLATION

Install horizontal joint reinforcement as indicated. Reinforcement shall be lapped not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement to provide not less than 5/8 inch cover to each face of the unit.

3.6 PLACING GROUT

Grout wall solid. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells occur during construction, the wall shall be torn down and rebuilt.

3.6.1 Grout Holes and Cleanouts

3.6.1.1 Grout Holes

Provide openings spaced not more than 16 inches on centers to facilitate grouting. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.6.2 Grouting Equipment

3.6.2.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, remove waste

materials and debris from the equipment, and dispose of outside the masonry.

3.6.2.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.6.3 Grout Placement

Lay masonry to the top of a pour before placing grout. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table II. Low-lift grout methods may be used on pours up to and including 5 feet in height.

3.6.3.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table II.

TABLE II POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS			
Maximum Grout Pour Height feet	Grout Type	Grouting Procedure	Hollow-unit Masonry
1	Fine	Low Lift	1-1/2 x 2
2	Fine	Low Lift	2 x 3

Notes:

- (1) The actual grout space or cell dimension shall be larger than the sum of the following items:
 - (a) The required minimum dimensions of total clear areas given in the table above;
 - (b) The width of any mortar projections within the space;
 - (c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated. Reinforcement shall be continuous, including around corners. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.8 LINTELS

3.8.1 Masonry Lintels

Construct masonry lintels as bond beams. Provide solid-bottom lintel units above openings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.9 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.9.1 Dry-Brushing

- a. Installed masonry shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.10 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.10.1 Separate and Recycle Waste

Place materials defined as hazardous or toxic waste in designated containers. Fold up metal banding, flatten, and place in designated area for recycling. Collect wood packing shims and pallets and place in designated area.

3.11 TEST REPORTS

3.11.1 Field Testing of Mortar

Take at least three specimens of mortar each day. Spread a layer of mortar 1/2 to 5/8 inch thick on the masonry units and allowed to stand for one minute. Prepare and test the specimens for compressive strength in accordance with ASTM C780. Submit test results.

3.11.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days. Submit test results.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL

05/14

PART 1 GENERAL

This section covers all anchors and bolts required for the exterior structural work including the sheeting and fender system. Base bid anchors, nuts, and washers for sheeting system and fender system shall be hot dipped galvanized in accordance with this specification. Stainless steel anchors shall be provided under Option 7. If this option is selected, all anchors for the sheeting system shall be stainless steel. All nuts and washers shall be a compatible stainless steel.

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

ASTM INTERNATIONAL (ASTM)

ASTM A193/A193M (2014) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications

ASTM A276 (2013a) Standard Specification for Stainless Steel Bars and Shapes

ASTM A307 (2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A36/A36M (2012) Standard Specification for Carbon Structural Steel

ASTM A563 (2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts

ASTM E488/E488M (2010) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

ASTM F1554 (2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield 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 F844 (2007a; R 2013) Washers, Steel, Plain
(Flat), Unhardened for General Use

STATE OF MAINE, DEPARTMENT OF TRANSPORTATION (MEDOT)

MEDOT (2014) State of Maine, Department of
Transportation, Standard Specifications

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-05 Design Data

Anchor Installation and Testing Plan; G

SD-06 Test Reports

Bolts, nuts, and washers; G

Bolt Testing Reports; G

Testing Reports; G

SD-07 Certificates

Bolts, nuts, and washers; G

Galvanizing; G

Anchor Testing Personnel; G

Testing Equipment and Procedures; G

1.3 ANCHOR INSTALLATION AND TESTING PLAN

Contractor shall develop and submit an Anchor Installation Plan including information on installation procedures, methods for verifying embedment depth, and anchor alignment. Plan shall also include manufacturer's information on anchor grout installation and methods for determining adhesive has filled hole completely.

Provide detailed plan for testing sheeting anchors. Testing shall not load or stress FRP sheeting.

PART 2 PRODUCTS

2.1 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.

2.1.1 Common Grade Bolts

Common grade bolts shall be used for angle connection at the top of the

sheeting and the corner connections.

2.1.1.1 Bolts

ASTM A307, Grade A, hot dipped galvanized bolts. The bolt heads and the nuts of the supplied fasteners shall be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.1.1.2 Nuts

ASTM A563, Grade A, galvanized heavy hex style.

2.1.1.3 Washers

ASTM F844 galvanized.

2.1.2 Sheeting and Fender Anchors

Threaded rods shall be used for all anchor rods on the FRP sheeting and fender system.

2.1.2.1 Anchor Rods

ASTM F1554 Gr 36, Class 1A, hot-dipped galvanized. Stainless steel anchors shall be in accordance with ASTM A193/A193M. Stainless steel anchors as noted on the drawings above the MHHW line are part of the base bid. Under Option 7, provide stainless steel anchors for the entire system.

2.1.2.2 Anchor Nuts

ASTM A563, Grade A, galvanized hex style. Stainless steel ASTM A193/A193M.

2.1.2.3 Anchor Washers

ASTM F844 galvanized. Stainless steel Type 316 conforming to ASTM A276.

2.1.2.4 Anchor Plate Washers

ASTM A36/A36M galvanized. Stainless steel Type 316 conforming to ASTM A276 and matching FRP sheeting manufacturer's written recommendations.

2.2 GALVANIZING

ASTM F2329 for threaded parts. All steel connections for exterior work shall be hot dipped galvanized.

2.3 ANCHOR GROUT

Tie rods used with FRP sheeting and bolts for the fender system shall utilize an epoxy grout in accordance MEDOT Qualified Products List of Anchoring Materials suitable for horizontal applications and approved by the Contracting Officer.

2.4 TESTING EQUIPMENT AND PROCEDURES

Provide testing equipment consisting of a hydraulic jack with calibrated pressure gauge for applying the load and a dial gauge or vernier scale to

measure anchor movement. The ram travel of the stressing equipment shall be not less than the theoretical elastic elongation of the total anchor length at the maximum Test Load. The pressure gauge shall be graduated in 100 psi increments. The stressing equipment and pressure gauge must have been calibrated as a unit no more than 30 calendar days prior to commencing work under this contract and at six-month intervals throughout the period of use. The movement measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum Test Load without resetting the device. An approved dial gauge or vernier scale and stand shall be provided to measure movement of the anchor.

PART 3 EXECUTION

3.1 STORAGE

Material must be stored out of contact with the ground in such a 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 Bolts and Threaded Rod

ASTM A307 bolts and threaded rod 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 the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. Electricity for the testing shall be furnished by the Government as set forth in Section 01 50 00.00 22 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS (PWD ME). 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.

3.3.1 Sheeting Anchors Material Testing and Inspection

3.3.1.1 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 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.

3.3.1.2 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.

3.4 SHEETING AND ANCHOR INSTALLATION

Perform anchor installation in accordance with manufacturer's instructions. Anchor embedment's shall be as indicated.

Drill holes with rotary impact hammer drills using carbide-tipped bits. Drill bits shall be of diameters as specified by the anchor manufacturer. All holes shall be drilled perpendicular to the concrete surface.

Clean all holes to remove loose material and drilling dust prior to installation of grout. Holes shall be saturated surface dry. Pump or inject grout into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the grout. Sufficient grout shall be injected in the hole to ensure that the annular gap is filled to the surface. Install damp anchor into hole and remove excess grout from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load until the grout has cured for the specified time. Holes underwater shall be flushed to remove debris. All installations shall be completed in accordance with the manufacturers written instructions.

3.5 SHEETING ANCHOR IN PLACE TESTING

Anchor testing shall be completed by an independent testing agency. Contractor shall submit experience and qualification for the Anchor Testing Personnel. Anchor shall be tested in tension utilizing the Incremental Load Application Test in accordance with ASTM E488/E488M Tension Testing. Proof load shall be maintained for a minimum of 10 minutes.

All tested anchors shall be tested to 70% of the anchor yield strength. The first five anchor dowels installed above and below water shall be tested to show appropriate materials and installation methods. Additionally, the Contractor shall be prepared to test up to 25% of the installed anchors as randomly selected by the Contracting Officer.

Anchors that fail testing shall be removed and reinstalled at no additional cost to the Government. Failure is considered one of the following:

1. Failure to reach Proof Load of 70% yield strength of the steel.
2. A permanent set remains after load is released.
3. Displacement greater than elastic stretch of the materials under required load.

After an anchor test failure, the next 5 anchors or more shall be tested as required by the Contracting Officer.

Contractor shall submit all Testing Reports to the Contracting Officer

within 24 hours of test completion.

Contractor shall provide oversized holes with pipe sleeves thru the FRP sheeting to facilitate anchor testing. No load shall be applied to the sheeting. All anchors tested underwater shall be completed by QC dive team under direct supervision and training of anchor testing personnel.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING

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 IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI S200	(2007) North American Standard for Cold-Formed Steel Framing - General Provision
AISI S201	(2007) North American Standard for Cold-Formed Steel Framing - Product Data
AISI S202	(2011) Code of Standard Practice for Cold-formed Steel Structural Framing
AISI S211	(2007) North American Standard for Cold-Formed Steel Framing - Wall Stud Design
AISI S212	(2007) North American Standard for Cold-Formed Steel Framing - Header Design
AISI S213	(2007; Suppl 1 2009) North American Standard for Cold-Formed Steel Framing - Lateral Design
AISI SG02-KIT	(2001; Supp 1 2004) North American Specification for the Design of Cold-Formed Steel Structural Members

ASTM INTERNATIONAL (ASTM)

ASTM A1003/A1003M	(2013b) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
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 A370	(2013) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1007	(2011a) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM C955	(2011c) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E329	(2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM F1941	(2010) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F1941M	(2007) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Metric)

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

Framing Components; G

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

SD-03 Product Data

Steel studs, joists, tracks, bracing, bridging and accessories

SD-07 Certificates

Load-bearing cold-formed metal framing

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground, support on a level platform, and protect from the weather as approved. Handle materials to prevent damage. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust. Replace damaged items with new, as directed by the Contracting Officer. Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation.

1.5 QUALITY ASSURANCE

- a. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 for testing indicated.
- b. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- c. AISI Specifications and Standards: Comply with:
 1. AISI S100, "North American Specification for the Design of Cold-Formed Steel Structural Members".
 2. AISI S200, "North American Standard for Cold-Formed Steel Framing - General Provision".
 3. AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".
 4. AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
 5. AISI S211, "North American Standard for Cold-Formed Steel Framing

- Wall Stud Design".

6. AISI S212, "North American Standard for Cold-Formed Steel Framing - Header Design".
7. AISI S213, "North American Standard for Cold-Formed Steel Framing - Lateral Design".

1.5.1 Drawing Requirements

Submit shop drawings for framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

- a. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 1. Grade: ST50H.
 2. Coating: G90.
- b. Steel Sheet for Clips: ASTM A1003/A1003M, ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: 50.
 2. Coating: G90.
- c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: As indicated.
 2. Flange Width: As indicated.
- d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 1. Minimum Base-Metal Thickness: Matching steel studs.
 2. Flange Width: 1-1/4 inches.

2.1.1 Studs and Joists of 16 Gage (0.0538 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G90.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

- a. An ICC number.

- b. Manufacturer's identification.
- c. Minimum delivered uncoated steel thickness.
- d. Protective coating designator.
- e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling, tapping screws in compliance with ASTM C1513 of the type, size and location as shown on the drawings. Electroplated screws shall have a minimum 5 micron zinc coating in accordance with ASTM F1941. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by using self-drilling or self-tapping screws.

3.1.1 Screws

Screws shall be of the self-drilling self-tapping type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-KIT. Screws covered by sheathing materials shall have low profile heads.

3.1.2 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.2 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over

and under openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. Provide horizontal bracing in web of each stud and secured to studs by screwing clip angles to studs. Bracing shall be the same size as the wall studs and spaced not more than 3'-4" on center.

3.2.3 Joists

Locate each joist directly above a stud. Joists shall have at least 2.50 inches of bearing on steel and shall be reinforced over bearings to prevent web crippling. Provide manufacturer's standard bridging which shall be as indicated but not less than one row near center of span.

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard shall be within the following limits:

- (1) Layout of walls: 1/4 inch from intended position;
- (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
- (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- (4) Face of framing members: 1/4 inch in 8 feet from a true plane.

-- 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 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 B18.21.1 (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 A167 (1999; R 2009) Standard Specification for
Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and
Strip

ASTM A193 (2014) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A276	(2013a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A467/A467M	(2007; R 2012) Standard Specification for Machine Coil Chain
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 A666	(2010) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C1513	(2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E488/E488M	(2010) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Mechanical Equipment Shields; G

SD-03 Product Data

Guard Posts (Bollards/Pipe Guards)
Safety Chains

SD-07 Certificates

Stainless Steel Shields

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 Stainless Steel Shapes

ASTM A276, Type 316, Mill Finish.

2.1.2 Structural Steel Pipe (Guard Posts)

ASTM A53/A53M, Type E or S, Grade B.

2.1.3 Stainless Steel Plate

ASTM A276, Type 316.

2.1.4 Stainless Steel Shields

ASTM A167 or ASTM A666, Type 316 of gauge indicated.

2.1.5 Stainless Steel Threaded Rod

ASTM A193, Type 316 with threaded ends or fully threaded diameter as indicated.

2.1.6 Stainless Steel

Fabricate custom shaped equipment shields of stainless steel sheet of gauge indicated to extend 4 inches beyond each edge of the mechanical equipment they cover. Coordinate sizes with the mechanical equipment to be shielded. Refer to Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.1.7 Expansion Anchors or Sleeve Anchors

Provide stainless steel expansion anchors or sleeve anchors as indicated. Minimum concrete embedment shall be as indicated. Design values indicated shall be as tested according to ASTM E488/E488M.

2.1.7.1 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.2 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.7.3 Washers

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

2.1.8 Stainless Steel Products

ASTM F593, Type 316 for use with stainless steel plates and shapes and as indicated.

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, 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 not be exposed to view 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, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

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

2.3 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 8 inch galvanized extra strong weight steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 3000 psi.

2.4 MISCELLANEOUS PLATES AND SHAPES

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

Provide angles and plates, ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A123/A123M.

2.5 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, 1/4 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 where indicated.

2.6 MECHANICAL EQUIPMENT SHIELDS

Fabricate of stainless steel sheets in the configuration indicated. Coordinate steel with mechanical equipment to be shielded. Refer to Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal

and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

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

3.5 WELDING

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

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

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

3.7 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically prior to drilling holes for expansion anchors. Provide nonshrink nonmetallic grout to level base plate prior to final tightening of expansion anchors. Fill the hollow core of the pipe with concrete having a compressive strength of 3000 psi.

3.8 MOUNTING OF SAFETY CHAINS

Mount safety chains as indicated.

3.9 INSTALLATION OF MECHANICAL EQUIPMENT SHIELDS

Field bend stainless steel shields around other appurtenances that are installed above the equipment being shielded. Support the shields with stainless steel rods, each end threaded, using stainless steel washers, nuts and threaded inserts recessed into the existing concrete slabs. Locate threaded rods in a manner that will not cut into or disturb the existing reinforcing steel in the existing concrete slabs and provide support for the equipment shields.

-- End of Section --

SECTION 05 51 00

METAL STAIRS

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 314 (1990; R 2008) Standard Specification for
Steel Anchor Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A242/A242M (2013) Standard Specification for
High-Strength Low-Alloy Structural Steel

ASTM A793 (2014) Standard Specification for Rolled
Floor Plate, Stainless Steel

ASTM E488/E488M (2010) Standard Test Methods for Strength
of Anchors in Concrete and Masonry Elements

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

Stainless Steel Hardware; G

Structural Stainless Steel, Plates, Shapes and Bars; G

Stainless Steel Circular Stair and Hand Rail System; G

Submit shop drawings signed and sealed by a licensed professional engineer.

SD-03 Product Data

Structural Stainless Steel Plates, Shapes, and Bars; G

Structural Stainless Steel Tubing; G

Masonry Anchorage Devices; G

Stainless Steel Circular Stair and Hand Rail System; G

SD-05 Design Data

Metal Stair Calculations; G

Submit calculations signed and sealed by the licensed professional engineer responsible for their preparation. The professional engineer shall be legally qualified to practice in the jurisdiction where the project is located.

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

SD-08 Manufacturer's Instructions

Masonry Anchorage Devices; G

1.3 QUALIFICATIONS FOR WELDING WORK

Submit welding procedures in accordance with AWS D1.1/D1.1M.

Certify welder qualification by tests in accordance with AWS D1.1/D1.1M. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, ensure that an immediate retest of two test welds and each test weld is made and passes. Failure in the immediate retest requires that the welder be retested after further practice or training and a complete set of test welds made.

1.4 METAL STAIR CALCULATIONS

Submit metal stair calculations to verify sizes, gages, and spacing of members and connections. Provide metal stair construction capable of withstanding loads in compliance with UFC 3-310-01 and as indicated. Treads shall be designed for a uniform load of 400 lb/sf.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Submit complete and detailed fabrication drawings for stainless steel hardware, and for steel shapes, plates, bars, strips, fasteners and connecting hardware used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by

grinding, or by welding and grinding.

2.2 STRUCTURAL STAINLESS STEEL PLATES, SHAPES AND BARS

Structural-size shapes and plates, conforming to ASTM A242/A242M, Type 316, except bent or cold-formed plates.

Stainless steel plates - bent or cold-formed, conforming to Type 316.

Stainless steel diamond plates - conforming to ASTM A793, Type 316.

Stainless steel bars and bar-size shapes, conforming to Type 316, unless otherwise noted for steel bars and bar-size shapes.

2.3 STRUCTURAL STAINLESS STEEL TUBING

Structural stainless steel tubing, hot-formed, welded or seamless, conforming to ASTM A242/A242M, Type 316.

2.4 STEEL PIPE

Stainless steel pipe conforming to Type 316.

2.5 MASONRY ANCHORAGE DEVICES

Provide stainless steel masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and in compliance with manufacturer's written instructions.

2.6 STAINLESS STEEL HARDWARE

Provide stainless steel hardware and fasteners in compliance with manufacturer's written instructions.

2.7 GENERAL FABRICATION

Prepare and submit stainless steel circular stair and hand rail system shop drawings based on field verified conditions, with detailed plans and elevations at not less than 1 inch to 1 foot with details of sections and connections at not less than 3 inches to 1 foot. Also detail placement drawings, diagrams, templates for installation of anchorage, including but not limited to, concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Continuously weld corners and seams in accordance with the recommendations of AWS D1.1/D1.1M. Grind welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide and coordinate anchorage of the type required by design for the supporting structure. Fabricate anchoring devices, space as required to provide adequate support for the intended use of the work.

2.8 STAINLESS STEEL CIRCULAR STAIR AND HAND RAIL SYSTEM

Provide standard open riser design in stainless steel. Construct center pole from circular cold drawn seamless tube, with cap at top and base plate having countersunk machine screws and expansion shields for fastening to concrete slab. Construct treads and platforms from stainless steel diamond plate; construct hand rails and supports from stainless steel.

PART 3 EXECUTION

3.1 STAINLESS STEEL CIRCULAR STAIR AND HAND RAIL SYSTEM

Provide anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation. Provide lock washers under nuts. Provide stainless steel fasteners in compliance with manufacturer's written instructions. Field verify existing conditions prior to shop drawings and fabrication.

3.2 FIELD WELDING

Execute procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work in compliance with AWS D1.1/D1.1M.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS

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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 314 (1990; R 2008) Standard Specification for
Steel Anchor Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding
Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A242/A242M (2013) Standard Specification for
High-Strength Low-Alloy Structural Steel

ASTM E488/E488M (2010) Standard Test Methods for Strength
of Anchors in Concrete and Masonry Elements

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521 (2001) Pipe Railing 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 approval. Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

Stainless Steel Hardware; G

Stainless Steel Shapes, Plates, Bars and Strips; G

Submit shop drawings signed and sealed by a licensed professional engineer.

SD-03 Product Data

Structural Stainless Steel Plates, Shapes, and Bars; G

Structural Stainless Steel Tubing; G

Masonry Anchorage Devices; G

Stainless Steel Railings and Handrails; G

SD-05 Design Data

Metal Railing Calculations; G

Submit calculations signed and sealed by the licensed professional engineer responsible for their preparation. The professional engineer shall be legally qualified to practice in the jurisdiction where the project is located.

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

1.3 QUALITY ASSURANCE

1.3.1 Welding Procedures

Submit welding procedures testing in accordance with AWS D1.1/D1.1M.

1.3.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition be performed on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, make an immediate retest of two test welds and ensure each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

1.3.3 METAL RAILING CALCULATIONS

Submit metal railing calculations to verify sizes, gages, and spacing of members and connections. Provide metal railing construction capable of withstanding loads in compliance with UFC 3-310-01.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication drawings for all stainless steel hardware, and for all stainless steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping, handling and access into the space. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks,

roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding.

2.2 GENERAL FABRICATION

Provide railings and handrails detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.3 STRUCTURAL STAINLESS STEEL PLATES, SHAPES AND BARS

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A242/A242M, Type 316, unless otherwise noted.

Provide stainless steel plates, to be bent or cold-formed, conforming to ASTM A242/A242M, Type 316.

Provide stainless steel bars and bar-size shapes conforming to ASTM A242/A242M, Type 316, unless otherwise noted.

2.4 STRUCTURAL STAINLESS STEEL TUBING

Provide structural stainless steel tubing, hot-formed, welded or seamless, conforming to ASTM A242/A242M, Type 316, unless otherwise noted.

2.5 STAINLESS STEEL PIPE

Provide pipe conforming to Type 316.

2.6 MASONRY ANCHORAGE DEVICES

Provide stainless steel masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and in compliance with manufacturer's written instructions.

2.7 STAINLESS STEEL HARDWARE

Provide stainless steel hardware and fasteners in compliance with manufacturer's written instructions.

2.8 STAINLESS STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.8.1 Stainless Steel Handrails

Provide stainless steel handrails, including inserts in concrete, stainless steel pipe conforming to Type 316 or structural tubing. Provide stainless steel railings of 1 1/2 inches nominal size.

a. Fabrication: Join posts, rail, and corners by one of the following methods:

- (1) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.
- (2) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

Provide stainless steel railings, including pipe, fittings, brackets, fasteners, and other components.

PART 3 EXECUTION

3.1 PREPARATION

Adjust stair railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts as indicated. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

Anchor rail ends into concrete and masonry with stainless steel round flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets with not less than 3-inch projection from the finish wall surface to the center of the pipe drilled to receive one 3/8-inch bolt, unless indicated otherwise. Locate brackets not more than 60 inches on center. Provide wall return fittings of flush-type, with the same projection as that specified for wall brackets.

Secure wall brackets and wall return fittings to building construction as follows:

For concrete use bolt anchor expansion shields.

3.2 STAINLESS STEEL HANDRAIL

Install with expansion shields and bolts. Secure rail ends by stainless steel pipe flanges anchored by expansion shields and bolts.

3.3 FIELD WELDING

Ensure procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

-- 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 LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2010) American Softwood Lumber Standard

AMERICAN WOOD COUNCIL (AWC)

AWC WFCM (2012) Wood Frame Construction Manual for One- and Two-Family Dwellings

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 (2010) Nonpressure Preservatives

AWPA P5 (2007) Standard for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870 (2010) Voluntary Product Standard, PS 1-09, Structural Plywood

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (2010) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)

ASME B18.5.2.1M (2006; R 2011) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M (1982; R 2010) Metric Round Head Square Neck Bolts

ASME B18.6.1 (1981; R 2008) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2013) Standard Grading Rules for Northeastern Lumber
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SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber
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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. Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-03 Product Data

SD-06 Test Reports

Preservative-treated lumber

SD-07 Certificates

Preservative treatment

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. 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 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.4.2 Preservative-Treated Lumber

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.

1.5 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, 19 percent maximum
- b. Materials other than lumber; moisture content shall be in accordance with standard under which the product is produced

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. 0.40 pcf intended for ground contact and fresh water use. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items shall be preservative treated:
 - 1. Wood members that are less than 24 inches from the ground. Nailers and blocking that are set into or in contact with concrete or masonry.
 - 2. Other wood members indicated to be preservative (pressure) treated.

1.7.1 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 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood at interior spaces, provide temporary ventilation.

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. Lumber shall be FSC-certified.

2.2 LUMBER

2.2.1 Framing Lumber

Framing lumber such as blocking and nailers shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing Lumber		
Grading Rules	Species	Framing

SPIB 1003 standard grading rules	Southern Pine	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)
NELMA Grading Rules standard grading rules	Balsam Fir, Eastern Hemlock-Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine-Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)

2.3 PLYWOOD

2.3.1 Marine Grade Plywood

B-B Grade, Exterior PS 1 Panel with a fully water resistant bonding adhesive and an Identification Index of not less than 24/0.

2.4 OTHER MATERIALS

2.4.1 Miscellaneous Wood Members

2.4.1.1 Blocking

Blocking shall be standard or number 2 grade.

2.5 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. 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.

2.5.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.5.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.5.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 3/8 inch.

2.5.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.5.5 Wood Screws

ASME B18.6.1.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AWC WFCM and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Frame members for the passage of pipes, conduits, and ducts. Provide adequate support as appropriate to the application, climate, and modulus of elasticity of the product. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Perform bolting in an approved manner. Bolts shall be drawn up tight.

3.2 MISCELLANEOUS

3.2.1 Wood Nailers

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.2 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.

3.2.3 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior entrance to pump well. Cover unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate work areas from existing equipment and as directed by the Contracting Officer's Representative.

3.2.4 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified in Section 04 20 00 MASONRY. Forms and centering for cast-in-place concrete work are specified in Section 03 31 29 MARINE CONCRETE.

3.3 WASTE MANAGEMENT

In accordance with the Waste Management Plan and as specified. Clearly separate damaged wood and other scrap lumber for acceptable alternative uses on site, including bracing, blocking, cripples, ties, and shims.

Separate treated, stained, painted, and contaminated wood and place in

designated area for hazardous materials. Dispose of according to local regulations. Do not burn scrap lumber that has been pressure treated, or lumber that is less than one year old.

-- End of Section --

SECTION 06 73 01

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING AND LADDER

02/12

PART 1 GENERAL

1.1 SUMMARY

This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) grating for elevated platforms and walkways.

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 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 D2344/D2344M (2013) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

ASTM D2863 (2013) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM D635 (2010) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D638 (2010) Standard Test Method for Tensile Properties of Plastics

ASTM D696 (2008; E 2013) 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 D790 (2010) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D953 (2010) Standard Test Method for Bearing Strength of Plastics

ASTM E662 (2013d) Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

ASTM E84 (2014) Standard Test Method for Surface
Burning Characteristics of Building
Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2012) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-17-3 (2002; Rev F; CANC Notice 1) Composite
Materials Handbook, Vol. 3, Polymer Matrix
Composites Material Usage, Design, and
Analysis

UNDERWRITERS LABORATORIES (UL)

UL 94 (2013) Standard for Tests for Flammability
of Plastic Materials for Parts in Devices
and Appliances

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Structural Performance of Gratings

Provide gratings capable of withstanding the effects of gravity loads in accordance with ASCE 7, ICC IBC, and the following loads and stresses within limits and under conditions indicated:

Walkways and Elevated Platforms: Uniform load of 200 lb/sq.ft.

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

Installation Drawings, Templates, and Directions; G

SD-03 Product Data

FRP Grating; G

Clips and Anchorage; G

FRP Ladder Components; G

SD-06 Test Reports

Bearing Strength Testing; G

Flexural Properties; G

Shear Strength; G

Tensile Properties; G

Toxicity Testing; G

Coefficient of Lineal Thermal Expansion; G

Flame Spread Testing; G

SD-07 Certificates

Manufacturer's Sample Warranty; G

Certification of Anchorage System compliance with ASCE 7; G

Manufacturer's Certification of Installation; G

SD-08 Manufacturer's Instructions

Shipping, Handling, Erection Procedures; G

Care and Maintenance Instructions; G

SD-11 Closeout Submittals

Manufacturer's Warranty; G

1.5 QUALITY ASSURANCE

Provide items by manufacturers having a minimum of ten years experience in the design and manufacture of similar products and systems. Submit a record of at least five previous, separate, similar successful installations in the last five years. Submit Manufacturer's catalog data to include two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:

- a. FRP Grating
- b. Clips and Anchorage
- c. FRP Ladder Components

Provide three-year manufacturer's limited warranty on FRP products against defects in materials and workmanship. Submit and obtain Contracting Officer's approval of Manufacturer's Sample Warranty prior to ordering materials.

Submit installation drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete.

Submit Certification of Anchorage System compliance with ASCE 7. Deliver such items to Contracting Officer and the Project site prior to commencement of installation.

1.6 PRODUCT DELIVERY AND STORAGE

Submit Manufacturer's recommendations for shipping, handling, erection procedures, and care and maintenance instructions upon completion of installation. Deliver manufactured materials in original, unbroken

pallets, packages, containers, or bundles bearing the label of the manufacturer. Ensure all adhesives, resins and their catalysts and hardeners are crated or boxed separately, and noted as such to facilitate their movement to a dry indoor storage facility.

Carefully handle all materials to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees F until they are required.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

Provide gratings composed of continuous roving fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified.

Provide resin of isophthalic polyester with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties conforming to the specified requirements.

Submit documentation for the following product tests prior to commencement of work:

- a. Bearing Strength Testing conforming to ASTM D953 and "Structural Performance Requirements" specified above.
- b. Flexural Properties conforming to ASTM D790
 - (1) Minimum Flexural Strength - 30,000 psi
 - (2) Minimum Flexural Modulus - 1,800,000 psi
- d. Shear Strength conforming to ASTM D2344/D2344M
 - (1) Minimum Shear Strength - 4,500 psi
- e. Tensile Properties conforming to ASTM D638
 - (1) Minimum Tensile Strength - 30,000 psi
- f. Toxicity Testing conforming to MIL-HDBK-17-3
- g. Coefficient of Lineal Thermal Expansion conforming to ASTM D696
 - (1) Required Value - 8.0 by 10 power minus in/in/degree F
- h. Flame Spread Testing conforming to ASTM D2863, ASTM E662, and UL 94

Ensure all surfaces of FRP items and fabrications are non-slip grit, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to ultraviolet, wear, or weathering.

Provide grating products with a flame spread rating of 25 or less per ASTM E84 Tunnel Test. Test gratings for burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per

ASTM D635.

2.1.1 Molded FRP Grating

Provide grating made as one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane with a square mesh pattern providing unidirectional strength and reinforced with continuous roving of equal number of layers in each direction, with the top layer of reinforcement no more than 1/8 inch below the top surface of the grating to provide maximum stiffness and prevent resin chipping of unreinforced surfaces having percentage of glass (by weight) not exceed 35 percent, so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements.

After molding, ensure no dry glass fibers are visible on any surface of bearing bars or cross bars, and that all bars are smooth and uniform with no evidence of fiber orientation irregularities, inter-laminar voids, porosity, resin rich or resin starved areas.

Non-slip surfacing to be integral with grating, manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance.

Grating bar intersections are to be filleted to a minimum radius of 1/16 inch to eliminate local stress concentrations and the possibility of resin cracking at these locations.

Grating to be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E84.

Banding: Flat Banding, Stainless Steel Type 304.

2.1.2 FRP Ladder

Fabricate ladder conforming to Section 7 of 29 CFR 1910.27. Ladder side rails, rungs, ladder mounting brackets are to be FRP structural shapes manufactured by the pultrusion process. Wall and floor brackets shall be of FRP molded construction or constructed out of 316 stainless steel. Provide ladder rail extension handrails.

2.1.3 Fasteners

General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners, clips and anchorage. Select fasteners for type, grade, and class required.

2.2 GRATING FABRICATION

Verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work.

Ensure all field and shop fabricated grating cuts are coated with vinyl ester resin to provide maximum corrosion resistance in accordance with the manufacturer's instructions. Provide banding indicated on drawings at locations.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Submit manufacturer's certification of installation. Verify all measurements and take all field measurements necessary before fabrication. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, to be included. Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack. Comply with recommendations of referenced bar grating standards, including installation clearances and standard anchoring details.

- a. Attach removable units to supporting members with type and size of clips and fasteners, as recommended by grating manufacturer for type of installation conditions shown.
- b. Attach non-removable units to supporting members by bolting as indicated above.

3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous FRP items securely in place. Include for anchorage not otherwise specified or indicated.

3.3 MANUFACTURER'S WARRANTY

Submit original and 3 copies of manufacturer's signed Warranty.

-- End of Section --

SECTION 06 90 01

FIBERGLASS REINFORCED PLASTIC (FRP) SHEETING

09/14

PART 1 GENERAL

This specification details the requirements design, fabrication, installation, and quality control for the FRP sheeting and wale system.

The design intent of this project is to reduce water infiltration into the pump well that is predominately entering through the cold joints in the existing concrete walls. The jacket system is designed to limit pathways to existing joints.

This is a performance based specification. The design of the sheeting system is the responsibility of the Contractor. This specification and the associated drawings define the minimum number of wales and anchor bolts. For the final installation the contractor's design may require additional anchorage or shoring depending on the contractor's means to control and place the concrete in fill. To limit the number of pathways through the jacket system this specification provides requirements on the maximum number and elevations of placements.

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 D1148 (2013) Standard Test Method for Rubber Deterioration-Discoloration from Ultraviolet (UV) and Heat Exposure of Light-Colored Surfaces

ASTM D4329 (2013) Standard Practice for Fluorescent UV Exposure of Plastics

ASTM D430 (2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue

ASTM D 6641 (2014) Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression (CLC) Test Fixture

ASTM D 5379 (2012) Standard Test Method for Shear Properties of Composite Materials by the V-Notched Beam Method

ASTM D570 (1998; E 2010; R 2010) Standard Test

	Method for Water Absorption of Plastics
ASTM D638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D 790	(2010) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D792	(2013) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

- Qualifications of Manufacturer; G
- Manufacturer's Sample Warranty; G
- Installation Work Plan; G

SD-02 Shop Drawings

- Installation Drawings; G

SD-03 Product Data

- Sheeting; G
- FRP Wale; G
- Plastic Block; G

SD-05 Design Data

- Design Calculations; G

SD-06 Test Reports

- Ultraviolet Test Reports; G
- Thermal Expansion Test Reports; G
- Flame Spread Test Reports; G

SD-07 Certificates

Manufacturer's Certification; G

Design Engineer's Qualifications; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-11 Closeout Submittals

Sheeting Installation Verification Report; G

Manufacturer's Warranty; G

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Manufacturer

Submit Qualifications of Manufacturer documenting that the Fiberglass Reinforced Plastic (FRP) manufacturer has a minimum of 5 years experience in manufacturing FRP products.

Submit Manufacturer's Certification.

Provide Manufacturer's sample warranty for all FRP products against defects in material and workmanship for a minimum of 5 years. Provide evidence of manufacturer's ISO 9001 standard certification.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Installation Work Plan

Submit a detailed installation work plan detailing all elements of the fiberglass sheeting and concrete backfill installation process. The following describes the minimum installation steps that shall be detailed in the work plan. Work plan shall include details of materials, equipment, processes, personnel, and quality control measures for each step. Alternatives and variations to this system shall be clearly detailed in the installation work plan for review and approval by the Contracting Officer.

1. Excavate area in front of pump well to allow sheeting installation. Excavation shall be performed by divers. Remove all loose sediment until stable soils are reached. Assume 4 feet of material removal for bidding purposes. In no instance shall less than 2 feet of material be removed.

2. Hydroblast face of pump well walls to remove all marine growth. A minimum of 10,000 psi hydroblast shall be required. Timing of hydroblast shall be scheduled to prevent regrowth prior to concrete placement.

3. Install lower section of sheeting by assembling sections adjacent to the pier, on a barge, and sliding them underneath the pier. Cutting the deck for sheeting installation shall not be permitted.

4. Provide additional support to sheeting as required to prevent damage during set up. Sheeting along each wall shall be continuous with all sheets connected by interlocks and additional supports as specified by the designer.
5. Install tie rods through sheeting. Drill oversized holes to allow confirmation of epoxy installation as well as pull testing. Utilize pipe sleeves or similar for pull testing of tie rods.
6. Pull test tie rods as detailed in Section 05 12 00 STRUCTURAL STEEL.
7. Install FRP patches over tie rods and pipe penetrations and extend pipe penetration as required. Ensure patches will prevent concrete from escaping sheeting.
8. Install wales and tighten as required by manufacturer and calculations.
9. Provide corner connection and end closures per drawings and manufacturer recommendations.
10. Backfill material that was excavated and place grout bags around exterior of sheeting to contain concrete placements.
11. Core holes in the deck for tremie placement. Provide steel plate covers for holes when not used for tremie placements.
12. Provide method for visual confirmation of concrete level during placement. Visual confirmation can be provided by view holes in the sheeting or other method.
13. Tremie place concrete seal (first placement) at the bottom of the form. Seal shall be a minimum of 3 feet and a maximum of 5 feet in height.
14. During tremie operations, provide means to separate concrete from mixing with seawater during placement such as a tremie ball or tremie pipe end closure. All tremie operations shall be in accordance with ACI and Maine DOT procedures.
15. Place second placement 7 days after first placement or once concrete has reached 0.80f'c. Concrete shall be placed moving from one tremie hole to the next in a circular pattern around the pump well. Coordinate lifts with tides to allow placement to occur during a rising tide. Concrete shall not exceed tide level by more than 6 inches. Stop second placement at EL 3.0 ft.
16. Install waterstop at top of second concrete placement prior to concrete setting. Leave concrete surface rough.
17. Remove upper wale 7 days after second placement or once concrete has reached 0.80f'c.
18. Clean exposed surface of second concrete placement prior to third concrete placement.
19. Install second level of sheeting outside of the first level allowing an overlap at the wale location. Re-attach wale. Attach remaining wales and upper angle connection.

20. Tremie place third concrete placement in dry conditions. Slope the upper surface of the west wall to ensure water will drain away from the wall of the pump well.

21. Fill concrete core holes within 48 hours of final concrete placement. Fill cores holes with non shrink cementitious grout.

22. Install Government furnished fender system panels 28 days following final concrete placement.

1.4.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, and dimensions. Show construction details, reinforcement, anchorage and installation. Include plans, elevations, sections, details, and attachments to other work.

Drawings shall be stamped by a licensed Professional Engineer.

1.4.3 Design Calculations

Calculations shall be stamped by a licensed Professional Engineer. Calculations shall be specific to the manufacturer and products selected. Minimum strength and dimensional requirements are provided herein and depicted on the drawings. The final design of the FRP sheeting system shall be the responsibility of the Contractor. Calculations shall include at a minimum the following:

- Sheeting moment, sheer and deflection properties
- Wale moment, shear, and deflection properties
- Wale spacing
- Tie Rod spacing and embedment depth
- Grout Properties
- Concrete lift height
- Tidal Influences
- Construction Loads
- Corner and End Closure Connections

Maximum deflection of the FRP sheeting and wale system system shall not exceed 1 inch.

Three separate placements shall be completed. A bottom closure placement 3-5 feet in height shall be required prior to placement of the remainder of the wall. The second placement shall extend to El +3.0 feet. The third placement shall be completed in the dry and extend from El +3.0 to the top of the wall.

Design of the FRP sheeting shall allow for three continuous placements and take into account the hydrostatic pressure of the concrete in submerged and unsubmerged states as appropriate with the tidal fluctuations in the river. This may require the elimination of retarders in the concrete mix to allow faster initial set times and therefore reducing the loads on the formwork system.

At no time shall the pour rate of the concrete exceed 5 feet/hour. Control concrete placement rate to prevent the formation of joints within each placement. No additional cold joints beyond those specified are allowed.

1.4.4 Design Engineer's Qualifications

All shop drawings and calculations shall be completed by a licensed Professional Engineer, in the State of Maine, with experience in the design of formwork subject to hydrostatic loads. Submit qualifications of design engineer for approval.

1.4.5 Product Data

Submit manufacturer's catalog data including two copies of manufacturer's specifications, load tables, and dimension diagrams for the following items:

- a. FRP Sheeting
- b. FRP Wale

1.4.6 Manufacturer's Instructions

Submit manufacturer's instructions for shipping, handling, erection procedures, and care and maintenance upon completion of installation.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver all manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer, clearly marked and identified relative to the complete system. Provide all adhesives, resins and their catalysts and hardeners in clearly marked or noted crates or boxes to facilitate their safe movement to a dry indoor storage facility with a constant temperature range between 70 and 85 degrees F until they are required.

Handle and store all materials to prevent abrasion, cracking, chipping, twisting, or other deformations and damage.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

All sheeting and wales shall be FRP structural shapes manufactured by the pultrusion process. Compose structural shapes of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7, this specification, and dimensions specified. Sheeting shall be designed to allow visual confirmation of concrete consolidation during placements.

Provide resins, with appropriate hardeners, of isophthalic polyester with chemical formulation necessary for corrosion resistance, strength and other physical properties as required.

All finished surfaces of FRP items are to be smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover all glass fibers with resin to protect against their exposure due to wear or weathering.

All pultruded structural shapes to be further protected from ultraviolet (UV) attack with:

- a. Integral UV inhibitors within the resin
- b. Synthetic surfacing veil to help produce a resin rich surface
- c. UV resistant coating for outdoor exposures

All FRP products to have a flame spread rating of 25 or less as per ASTM E84, Tunnel Test. Submit Flame Spread Test Reports to the Contracting Officer.

Submit Ultraviolet Test Reports for FRP material, similar to the requirements of ASTM D1148 for rubber deterioration, and ASTM D430, to the Contracting Officer. Also submit testing data relating to Thermal Expansion Test Reports.

The Sheeting shall meet the minimum properties as follows:

Nominal Moment Capacity	12,873 lb-ft/ft
Nominal Shear Capacity	31,200 lb/ft
Modulus of Elasticity	3,200 ksi
Moment of Inertia	52 in ⁴ /ft
Section Modulus	13 in ³ /ft

The FRP Wale shall be designed to be compatible with the sheeting, and provide support for temporary construction loads to maximize concrete lifts, and meet the minimum properties as follows:

Nominal Moment Capacity	41,600 lb-ft/ft
Nominal Shear Capacity	31,600 lb/ft
Moment of Inertia	49 in ⁴ /ft
Section Modulus	14 in ³ /ft
Modulus of Elasticity	3,160 ksi

Material properties for sheeting and wales shall be determined in accordance with ASTM D638 for tensile properties, ASTM D 6641 for compressive properties, ASTM D 790 for flexural properties, and ASTM D 5379 for shear properties. Alternative testing methods submitted for products shall include back up support for testing method used and comparison with listed test above.

2.2 Fender System Elements

Fender system shall consist of plastic fender elements, plastic blocking behind the fenders and all associated anchoring hardware. Only Marine Fender MF-1 shall be supplied by the Government. Fenders are located at the shipyard. Pick up from the designated location, modify, and install

the fenders as indicated on the drawings.

Submit plastic lumber certificates and delivery inspection checklist for plastic block. Field inspect and submit verification list for each member indicating condition.

Provide composite plastic lumber for blocking manufactured as specified. All plastic lumber shall be the product of a single manufacturer. Lumber shall be full size and in one piece. Splices are not allowed. Lumber shall be solid and homogenous throughout, without uncured material, air voids, pockets, segregated raw material, splits, cracks or fusion lines, crooks, twists, warps, or sweeps. All plastic lumber shall be delivered to the work site complete and ready to install.

Plastic shall be a mixture of one or more of the following thermoplastics: high-density polyethylene, polypropylene and low-density polyethylene with a minimum of 4.0 percent (by weight) carbon black. No used or rebuilt structural elements shall be used in the fabrication of the plastic lumber.

The minimum properties of the plastic shall be as follows:

Density (ASTM D792)	51.5 lb/cu.ft. minimum
Modulus of Elasticity	45,000 psi minimum
Max Yield Stress in Bending	Fb=850 psi
Compressive Modulus	45,000 psi minimum
Compressive Strength (ASTM D695)	1,750 psi minimum
Ultimate Tensile Strength (ASTM D638)	500 psi minimum
Water Absorption (ASTM D570)	Less than 3 percent weight increase in 24 hours
Ultraviolet (ASTM D4329 B Lamp)	No more than 10 percent change in Shore D durometer hardness after 500 hours exposure

PART 3 EXECUTION

3.1 EARTHWORK

Pre-excavation will be required. Pre-excavation shall be completed by divers. Backfill as indicated on drawings prior to concrete placements.

3.2 INSTALLATION

3.2.1 Excavation of Materials

Excavation required within the area where sheeting is to be installed shall be completed prior to placing sheeting. Material removal shall be no less than 2 feet and shall include all loose material.

3.2.2 Sheeting Installation

The deck of the pier is located above two sides of the pump well. Driving of sheets shall not be permitted. Sheeting shall be installed underneath the deck of the pier without cutting into the pier.

Sheeting shall be interlocked throughout their length with adjacent sheet to form a continuous diaphragm throughout the length or run of wall.

Splice sheeting as shown on the drawings.

Provide temporary wales, templates, or guided structures to ensure that the sheets are placed to the correct alignment. Mount sheeting to underdeck of pier during fit up.

Sheets shall be placed plumb, with out-of-plumbness not exceeding 1/8 inch per foot of length. Vertical elevations and horizontal alignment shall be within +/- 1 inch.

3.2.3 Wale Installation

Install and splice wales in accordance with Manufacturer's written recommendations. Wale anchor installation and testing requirements are detailed in specification section 05 12 00 Structural Steel.

3.3 QUALITY CONTROL

Quality control shall be completed in accordance with specification section 01 45 00.00 20 Quality Control (PWD ME). Quality control dive inspection are also defined in the Quality Control specification.

3.3.1 Design Engineers' Involvement

The design engineer shall be involved throughout the project to ensure proper installation. At a minimum in the following phases of the installation: design of fiberglass sheeting system submittal review, preparatory meeting prior to installation, after sheeting and wale installation, and during concrete placements.

3.3.2 Sheeting and Wale Inspection

Perform continuous inspection during the sheeting and wale placement process. Each section of sheeting and each wale shall be inspected for crack and defects prior to installation. After installation the elements shall be inspected again to ensure no damage occur during installation. All damaged or defective elements shall be replaced. The Contractor shall be responsible for all cost associated with replacement.

3.3.3 Installation Verification Reports

Submit a sheeting installation verification report for each section of sheeting. The report should include the following: pre-installation inspection verification, location of sheeting section, length of sheeting section, vertical and horizontal alignment verification, interlock connection verification, and post installation inspection verification.

3.4 WARRANTY

Submit signed copies of the Manufacturer's Warranty.

DRY DOCK #3 PUMP WELL REPAIRS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1332591

-- End of Section --

SECTION 07 41 13

METAL ROOF AND WALL PANELS

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.

ALUMINUM ASSOCIATION (AA)

AA ADM (2010) Aluminum Design Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100 (2012) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M (2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B209M (2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM C792 (2004; R 2008) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of

Elastomeric Sealants

ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2011) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2009; E 2010; R 2010) Measuring Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D5894	(2010) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D610	(2008; R 2012) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2009) Evaluating Degree of

Blistering of Paints

ASTM D822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646	(1995; R 2011) Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Air Pressure Difference
ASTM E72	(2014a) Conducting Strength Tests of Panels for Building Construction
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
FM GLOBAL (FM)	
FM 4471	(2010) Class I Panel Roofs
METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)	
MBMA MBSM	(2002) Metal Building Systems Manual
MBMA RSDM	(2000) Metal Roofing Systems Design Manual
NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)	
NRCA 0420	(2010) Architectural Metal Flashing, Condensation Control and Reroofing
NRCA RoofMan	(2011 thru 2014) The NRCA Roofing Manual
SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)	
SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition
UNDERWRITERS LABORATORIES (UL)	
UL 580	(2006; Reprint Oct 2013) Tests for Uplift

Resistance of Roof Assemblies

UL Bld Mat Dir

(2012) Building Materials Directory

1.2 DESCRIPTION OF METAL ROOF SYSTEM

1.2.1 Description of Roof Panel Systems

Factory color finished, metal roof system, with concealed fastening attachment. Panel profiles must be as shown on drawings or approved equal. Include attachment system components and accessories required for weathertight system.

1.2.2 Performance Requirements

Metal panels and accessory components must conform to the following standards:

ASTM A123/A123M

ASTM D522/D522M for applied coatings

UL Bld Mat Dir

1.2.2.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E1646. Submit leakage test report upon completion of installation. No water leakage at 30.0 pounds per square foot.

1.2.2.2 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Roof system and attachments must resist the wind loads as determined by ASCE 7, in pounds per square foot. Metal roof panels and component materials must also comply with the requirements in FM 4471 as part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

Design Load Data:

Wind Speed = 130 mph.

Exposure Category = C

Risk Category = 3

Sloped Roof Snow Load = 35 psf.

1.2.2.3 Roof Panel Structural Performance

Metal roof panels shall be capable of withstanding a 250 pound concentrated load applied to a 4 square inch area in the middle of the panel. No noticeable buckling or permanent distortion of the panel shall occur.

1.2.2.4 Wall Panel Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the

AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Contract drawings show the extent and general assembly details of the metal siding. Contractor must provide design for members and connections shown and not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the pad stress requirements in accordance with ASTM E1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by ASTM E72 and ASCE 7 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of Wind Load Tests to the Contracting Officer.

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 Panels; G

Wall Panels; G

Flashing and Accessories; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof panels; G

Wall Panels; G

Factory-Applied Color Finish; G

Accessories; G

Fasteners; G

SD-04 Samples

Roof Panels; G

Wall Panels; G

Factory-applied Color Finish, samples, 9 inch lengths, full width;
G

SD-05 Design Data

Roof Panel Wind Uplift Resistance; G

Roof Panel Structural Performance; G

Wall Panel Structural Performance; G

Wind Load Tests; G

As applicable, submit the following wind load design analysis data, to include, but not limited to:

Wind Speed
Exposure Category, Co-Efficient, Importance Factor
Type of Facility
Negative Pressures for Each Zone
Methods and Requirements of Attachment

SD-06 Test Reports

Leakage Test Report; G

Wind Uplift Test Report; G

Factory Finish and Color Performance Requirements; G

SD-07 Certificates

Qualification of Manufacturer; G

Qualification of Applicator; G

SD-08 Manufacturer's Instructions

INSTALLATION MANUAL; G

SD-11 Closeout Submittals

Warranties; G

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Submit documentation verifying metal roof and wall panel manufacturer has been in the business of manufacturing metal roof and wall panels for a period of not less than 5 years.

Manufacturer must also provide engineering services by an authorized structural engineer, currently licensed in the geographic area of the project, with a minimum of five (5) years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE 7, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.4.1.1 Single Source

Roofing and wall panels, clips, closures, and other accessories must be standard products of the same manufacturer, and the most recent design of the manufacturer to operate as a complete system for the intended use.

1.4.2 Qualification of Applicator

Metal roof and wall systems applicator must be approved, authorized, or licensed in writing by the roof and wall panel manufacturer and have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing and wall panel systems products submitted for this project within the previous three years.

1.4.3 Field Verification

Prior to the preparation of drawings and fabrication, verify location of roof and wall framing, roof and wall openings and other penetrations, and any other special conditions. Indicate all special conditions and measurements on final shop drawings.

1.4.4 Qualifications for Welding Work

Welding procedures must conform to AWS D1.1/D1.1M for steel or AWS D1.2/D1.2M for aluminum.

Operators are permitted to make only those types of weldments for which each is specifically qualified.

1.4.5 Pre-installation Conference

After approval of submittals and before performing metal panel system installation work, hold a pre-installation conference to review the following:

- a. Drawings, specifications, and submittals related to the work. Submit, as a minimum; sample profiles of metal roof and wall panels, with factory-applied color finish samples, flashing and accessories, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds. Also include technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.
- b. Roof and wall system components installation;
- c. Contractor's plan for coordination of the work of the various trades involved in providing the metal panel systems and other components secured to the metal panels;
- d. Quality control plan for the metal panel systems installation; and
- e. Safety requirements.

Coordinate pre-installation conference scheduling with the Contracting Officer. Attendance is mandatory for the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of metal panel systems, flashing and sheet metal work, and, other trades interfacing with the work, and representative of the metal panel manufacturer. Before beginning work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof and wall panel work.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle roof and wall panel materials, bulk products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.5.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site and immediately replace. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Handling

Handle materials in a manner to avoid damage. Select and operate material handling equipment so as not to damage materials or applied panels.

1.5.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.6 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit metal panel work to be performed according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.7 FABRICATION

Fabricate and finish metal panels and accessories on a rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profiles or approved equals, as indicated on drawings including major ribs and intermediate stiffening ribs for full length of panel. Fabricate panel side laps with factory installed captive gaskets or separator strips providing a weather tight seal and preventing metal-to-metal contact, and minimizing noise from movements within the panel assembly.

1.7.1 Finishes

Finish quality and application processes must conform to the related standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.7.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

- a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.
- b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- c. Sealed Joints: Form non-expansion, but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.
- d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
- e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal panel manufacturer for application, but not less than the thickness of the metal being secured.

1.8 WARRANTIES

Provide metal roof and wall panel systems material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.8.1 Metal Roof and Wall Panel Manufacturer Warranty

Furnish the metal panel manufacturer's 5-year no dollar limit roof and wall system materials and installation workmanship warranty, including flashing, components, trim, and accessories necessary for a watertight roof and wall system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof and wall panel work. The warranty must state that:

- a. If within the warranty period, the metal roof and wall panel 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, displaces, corrodes, perforates, 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 metal roof and wall panel system and correction of defective workmanship is the responsibility of the metal roof and wall panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof and wall panel manufacturer.
- b. If 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 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the roofing and wall panel systems. Issue the warranty directly to the Government at the date of Government acceptance. Warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D2244.

1.8.3 Metal Panel Systems Installer Warranty

Provide system installer warranty for a period of not less than two years that the system, as installed, is free from defects in installation workmanship, to include the roof and wall panel installations, flashing, accessories, attachments, and sheet metal installation integral to a complete watertight system assembly. Issue warranty directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials is the responsibility of the metal roof and wall panel systems installer. All costs associated with the repair or replacement work are the responsibility of the installer.

1.8.4 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved by the Contracting Officer, as required, and accomplished in a manner so as to restore the integrity of the roof and wall panel systems assembly and validity of the metal roof and wall panel system manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

The entire metal panel and flashing systems must be in accordance with specified and indicated requirements, including wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MBMA RSDM, NRCA RoofMan, the metal panel manufacturer's 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.

PART 2 PRODUCTS

2.1 METAL PANELS

2.1.1 Aluminum Sheet Panels

Roll-form aluminum roof panels and wall panels to the specified profile of 0.050 inch thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

- a. Aluminum sheet conforming to ASTM B209M and AA ADM.
- b. Individual panels to have continuous length sufficient to cover the entire length of any unbroken roof slope and wall height with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profiles:

1. Profiles shall be as shown on drawings.

2.2 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory-applied polyvinylidene fluoride finish consisting of a baked-on topcoat with a manufacturer's recommended prime coat conforming to the following:

- a. Metal Preparation: Prepare metal surfaces for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.
- b. Prime Coating: Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. The prime coat must be oven cured prior to application of the finish coat.
- c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 plus 0.05 mils for a total dry film thickness of 1.00 plus 0.10 mils. This exterior finish coat must be oven-cured.
- d. Interior finish coating: Apply a wash coat on the reverse side over primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. The wash coat must be oven cured.
- e. Color: The exterior finish(es) will be chosen from the manufacturer's standard color charts by the Contracting Officer.
- f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587
Abrasion:	ASTM D968
Adhesion:	ASTM D3359
Chalking:	ASTM D4214
Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894

Flame Spread:	ASTM E84
Flexibility:	ASTM D522/D522M
Formability:	ASTM D522/D522M
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 General

Provide cold formed metallic-coated steel sheet conforming to ASTM A653/A653M, AISI S100, and as specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.2 Fasteners for Miscellaneous Metal Framing

Provide compatible type, corrosion resistant, of sufficient size and length to penetrate the supporting element to fasten miscellaneous metal framing members to substrates in accordance with the metal panel manufacturer's and ASCE 7 requirements.

2.3.2.1 Screws

Provide corrosion resistant screws of the type and size recommended by the manufacturer to meet the performance requirements.

2.3.2.2 Rivets

Provide closed-end type rivets, corrosion resistant where watertight connections are required.

2.3.2.3 Attachment Clips

Provide clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.3.3 Electrodes for Manual, Shielded Metal Arc Welding

Electrodes for manual, shielded metal arc welding must meet the requirements of AWS D1.1/D1.1M, and be covered, mild-steel electrodes conforming to AWS A5.1/A5.1M.

2.4 ACCESSORIES

Accessories must be compatible with the metal roof and wall panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for metal panels. Provide exposed metal accessories to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other concealed closure strips must be closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water. Provide sealant, tapes or coatings as required to protect galvanization at dissimilar materials.

2.4.1 Pre-manufactured Accessories

Pre-manufactured accessories must be manufacturer's standard for intended purpose, compatible with the metal system and approved for use by the metal panel manufacturer.

2.4.2 Metal Closure Strips

Provide factory fabricated aluminum closure strips of the same gauge thickness, color, finish and profiles as the specified roof and wall panels.

2.4.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to ASTM D1056 and ASTM D1667, extruded or molded to the configuration of the specified roof and wall panel profiles and in lengths supplied by the panel manufacturer.

2.5 JOINT SEALANTS

2.5.1 Sealants

Sealants are to be per metal panel manufacturer's requirements. Sealant must dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining, in conformance with ASTM C792, is permitted on painted or unpainted metal.

Prime joints to receive sealants with a compatible one-component or two-component primer as recommended by the metal panel manufacturer.

2.5.1.1 Shop Applied Sealants

Sealant for shop-applied caulking must be per panel manufacturer's requirements and with a curing time which ensures the sealant's plasticity at the time of field erection. Color to match panel color.

2.5.1.2 Field Applied Sealants

Sealants for field-applied caulking must be per panel manufacturer's requirements and with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C920, Type II. Color to match panel color.

2.5.1.3 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release

paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the panel manufacturer.

2.5.2 Sheet Metal Flashing and Trim

2.5.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.6 FINISH REPAIR MATERIAL

Only use repair and touch-up paint supplied by the metal panel manufacturer that is compatible with the specified system.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the work. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine primary and secondary framing to verify that rafters, purlins, girts, wall framing, angels, channels, and other structural support members for panels and anchorages have been installed within alignment tolerances required by metal panel manufacturer, UL, ASTM, and ASCE 7 requirements.

Examine rough-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the Contracting Officer, endorsed by the installer, stating acceptance of conditions or listing conditions detrimental to the performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Installation must meet specified requirements and be in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Dissimilar materials which are not compatible when contacting each other must be insulated by means of gaskets or sealing/insulating compounds. Keep exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean substrate substances which may be harmful to roof and wall panels

including removing projections capable of interfering with with panel attachment.

Install sub-purlins, eave angles, furring, and other miscellaneous panel support members and anchorage according to metal panel manufacturer's written instructions.

3.3 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Protect wall panels from damage.

3.4 FASTENER INSTALLATION

Anchor metal panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions.

3.4.1 Welding

Procedures for manual, shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work must be in accordance with AWS D1.1/D1.1M.

3.5 ROOF FLASHING, TRIM, AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work must conform to the manufacturers written instructions.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, junctions between metal siding and roofing and changes of slope or direction in metal roofing.

Exposed metal flashing must be the same material, color, and finish as the specified metal roofing and wall panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and blind soldered end joints, with expansion joints at intervals of no greater than 16 feet.

Fasten flashing at not more than 8 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Exposed flashing and flashing subject to rain penetration must be bedded in specified joint sealant. Flashing which contacts dissimilar metals must be isolated by means of the panel manufacturer's recommended asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.6 ROOF PANEL INSTALLATION

Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA 0420.

Aluminum Roof Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior and aluminum fasteners for unexposed surfaces.

Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide blocking and nailers as required. Refer to Section 06 10 00 ROUGH CARPENTRY.

Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by permanent separation as recommended by the metal roof panel manufacturer.

Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.6.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or impact. Do not apply bent, chipped, or defective panels. Damaged panels must be replaced and removed from the site at the contractors expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure fluctuations.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.7 WALL PANEL INSTALLATION

Provide full length metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied. Damaged panels must be replaced and removed from the site at the contractors expense.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with

the indicated eave and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.7.1 Wall Panels

Use aluminum stainless-steel fasteners for exterior surfaces and aluminum fasteners for interior surfaces.

3.7.2 Anchor Clips

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.7.3 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.7.4 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

3.7.5 Fastener Installation

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.8 WALL PANEL FLASHING, TRIM AND CLOSURE INSTALLATION

3.8.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Install sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.8.2 Metal Flashing

Install exposed metal flashing at building corners, sills and eaves, junctions between metal siding and walling. Exposed metal flashing must be the same material, color, and finish as the specified metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.8.3 Wall Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.8.4 Roof Closure Strips

Install metal closure strips at open ends of ribbed pattern roofs, and at intersection of wall and roof, unless open ends are concealed with formed eave flashing; rake of metal roof unless open end has a formed flashing member; and in other required areas.

3.9 WORKMANSHIP

Make lines, arises, 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 which might affect the application. For installation of items not shown in detail or not covered by specifications, conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing wherever indicated and necessary to make the work watertight

3.10 ACCEPTANCE PROVISIONS

3.10.1 Erection Tolerances

Erect metal panels straight and true with plumb vertical and horizontal lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/8 inch in 40 feet.

3.10.2 Leakage Tests

Finished application of metal is to be subject to inspection and test for leakage by the Contractor. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.10.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements, and/or the Contracting Officer are to be immediately removed and replaced with new material at no additional cost to the Government.

3.11 FIELD QUALITY CONTROL

3.11.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

- a. Materials comply with the specified requirements.
- b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.
- c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of panels.
- d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.
- e. Side laps are formed, sealed, fastened or seam locked as required.
- f. The proper number, type, and spacing of attachment clips and fasteners are installed.
- g. Installer adheres to specified and detailed application parameters.
- h. Associated flashing and sheet metal are installed in a timely manner in accordance with the specified requirements.

Provide five bound copies of Manufacturer's Field Reports to the Contracting Officer two weeks prior to project close-out.

3.12 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs and surrounding area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish. Treat exposed cut edges with manufacturer supplied clear coat.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the Government property and legally dispose of them.

-- 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 E119	(2012a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E1399/E1399M	(1997; E 2013;R 2013) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E1966	(2007; R 2011) Fire-Resistive Joint Systems
ASTM E2174	(2010a; E 2011) 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 E699	(2009) Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components
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 2079	(2004; Reprint Dec 2012) Tests for Fire

Resistance of Building Joint Systems

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, including through-penetrations, membrane penetrations, and construction joints and gaps.

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Membrane-penetrations include, but are not limited to, the annular space around pipes, tubes, conduit, wires, cables, vents, and structural members that only penetrate one side of a rated wall assembly.
- c. Construction joints include, but are not limited to, those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.
- d. Gaps requiring firestopping include, but are not limited to, gaps between the top of the fire-rated walls and the roof or floor deck above, and gaps between the fire-rated walls and perimeter walls.

1.2.2 Sequencing

Coordinate the specified work with other trades. Coordinate material and length of sleeves, if used, with other trades and with firestopping assemblies selected. 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. 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 testing laboratory's designation for the firestopping assembly (such as UL W-L-1049), 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" ratings, and type of application. Provide firestopping assembly designations in a single submittal.

- b. Submit certificates attesting that firestopping material complies with the specified requirements. For 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 Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00
SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials; G

SD-03 Product Data

Signage Schedule

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 a single experienced firestopping 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.

- c. Firestopping installation is to be performed by this installer and not the individual trades.

1.4.2 Inspector Qualifications

The inspector shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and 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 each stage 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.

2.1.3.1 Through-Penetrations and Membrane-Penetrations

Firestopping materials for penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F" 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.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, and gaps shall be the same as the construction in which they occur. Where joints are between assemblies of two different fire resistance ratings the joint shall have an hourly rating meeting or exceeding the highest fire resistance rating of the two assemblies. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399/E1399M or UL 2079. Joints at the intersection of the top of a fire resistance rated wall and the underside of a floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Firestopping Manufacturer

Obtain firestopping systems for each type of penetration and construction condition and each type of joint from a single manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

- a. 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.
- b. Verify that penetrating items are rigidly supported on both sides of the assembly penetration unless otherwise permitted by the listed firestopping system.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations. Where sleeves are used, coordinate use of sleeve and length of sleeve with firestopping system selected.

- a. Penetrations of duct, conduit, tubing, cable and pipe through fire-resistance rated walls and partitions.
- b. Gaps at perimeter of fire-resistance rated walls and partitions, such

as between the top of the walls and the bottom of floor or roof decks.

- c. Construction joints in floors and fire rated walls and partitions.
- d. 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 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping devices.

3.2.2.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf (measured at ambient temperature and 400 degrees) at 0 percent to 100 percent visual fill.

3.3 IDENTIFICATION

Submit signage schedule that includes types, quantities, installation locations, job specific text, materials, fonts, and colors.

3.3.1 Penetration Firestopping

Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

- a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
- b. Contractor's name, address, and phone number.
- c. Designation of applicable testing agency, such as "UL W-L-1049".
- d. Date of installation.
- e. Manufacturer's name.
- f. Installer's name.

3.3.2 Joint Firestopping

Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

- a. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
- b. Contractor's name, address, and phone number.
- c. Designation of applicable testing agency, such as "UL HW-D-0094".
- d. Date of installation.
- e. Manufacturer's name.
- f. Installer's name.

3.3.3 Fire Rated Wall Identification

3.3.3.1 Signs

Identify fire rated walls with signs stating "Fire Wall - Do Not Penetrate". Apply signs using fluorescent red or orange paint over stencils. Letters shall be a minimum of 4 inches in height. Prevent overspray onto adjacent surfaces. If overspray does occur, clean-up or replacement of damaged surfaces is the responsibility of the Contractor. Space signs at a maximum of 10 foot intervals. In mechanical, electrical and similar rooms without ceilings, place signs 8 feet above the finished floor level.

3.4 INSPECTION

3.4.1 General Requirements

For Navy projects, install one of each type of penetration and joint firestopping assembly and have it inspected and accepted by the Mid Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer prior to the installation of the remainder of the firestopping assemblies. At this inspection, the Installer and Inspector 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. The inspector shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location and their condition; type shall be recorded by UL listed printed numbers. The Inspector shall submit a final Inspection Report indicating work is complete.

3.4.2 Inspection Standards

Inspect firestopping in accordance with ASTM E2393 and ASTM E2174 for

DRY DOCK #3 PUMP WELL REPAIRS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1332591

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

ASTM D1056 (2014) Standard Specification for Flexible
Cellular Materials - Sponge or Expanded
Rubber

1.2 SUBMITTALS

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

SD-03 Product Data

Schedule; G

Sealants; G

Primers; G

Bond breakers; G

Backer Rod; G

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-04 Samples

Color Charts; G

Mock-up; G

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

Special Warranty; G

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up prepared by other trades, using materials and techniques approved for use on the project.

1.6 SPECIAL WARRANTY

Warrant sealant joint against failure of sealant and against water penetration through each sealed joint for five years. Warranty shall cover materials and installation labor.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied. Submit product data, color charts, and schedule indicating where each product will be applied.

2.1.1 Interior Sealant

Provide ASTM C920, Type S or M, Grade P, Class 25, Use NT. Location(s) and color(s) of sealant for the following:

LOCATION	COLOR
a. Small voids between walls or partitions and door frames or surface-mounted equipment and fixtures, and similar items.	As selected
b. Perimeter of frames at doors and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected
d. Other locations as indicated and specified.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	As selected
b. Expansion and control joints.	As selected
c. Voids where items pass through exterior walls.	As selected
d. Metal-to-metal joints where sealant is indicated or specified.	As selected
e. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	As selected
f. Other locations as indicated and specified.	As selected

2.1.3 Floor Joint Sealant

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	As selected
b. Control and expansion joints in floors, slabs, and walkways.	As selected
c. Other locations as indicated and specified.	As selected

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKER ROD

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Neoprene

Conform to ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For concrete, masonry or other porous surfaces:		
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 Backer Rods

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, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent

as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 22 20

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES

05/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in 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 C1036 (2010; E 2012) Standard Specification for Flat Glass

ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

ASTM D2344/D2344M (2013) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

ASTM D256 (2010) Determining the Izod Pendulum Impact Resistance of Plastics

ASTM D635 (2010) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D638 (2010) Standard Test Method for Tensile Properties of Plastics

ASTM D695 (2010) Standard Test Method for Compressive Properties of Rigid Plastics

ASTM D696 (2008; E 2013) 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 D790 (2010) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM E2112 (2007) Standard Practice for Installation of Exterior Windows, Doors and Skylights

ASTM E119 (2012a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E84 (2014) Standard Test Method for Surface Burning Characteristics of Building Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2006) Hardware Preparation in Steel Doors and Steel Frames

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2012) International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2012; Amendment 1 2012) Life Safety Code

NFPA 241 (2013) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives

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

16 CFR 1201 Safety Standard for Architectural Glazing Materials

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for Construction

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance (2012) Fire Resistance Directory

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Sample Warranty

SD-02 Shop Drawings

Doors; G

Frames; G

Frame Anchors; G

SD-03 Product Data

Doors; G

Frames; G

SD-10 Operation and Maintenance Data

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

Warranty; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver FRP doors, frames, components and accessories in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.3.2 Storage

Protect materials against moisture absorption and contamination or other damage.

Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.

Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.

Do not store materials outdoors unless approved by the Contracting Officer. Completely cover materials stored outdoors 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 materials in contact with other materials that might cause staining, denting, or other surface damage.

1.3.3 Handling

Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

1.4 EXISTING CONDITIONS

1.4.1 Field Measurements

Take field measurements prior to the preparation of drawings and fabrication.

1.5 SAMPLE WARRANTY

Submit sample material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard manufacturer warranty as required to comply with the specified requirements.

1.6 WARRANTY

Furnish the manufacturer's 10 year no dollar limit for materials and installation, workmanship, and deterioration of factory-applied finishes within specified warranty period. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the work.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide door and frame components including, but not limited to, cores, faces, stiles, rails, heads, jambs, and internal reinforcement, which are FRP structural shapes manufactured by the pultrusion process. Ensure structural shapes are composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements in accordance with ASCE 7, ICC IBC and dimensions specified.

Ensure fiberglass reinforcements are a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

Verify resins are of isophthalic polyester with chemical formulation necessary for corrosion resistance, strength and other physical properties as required.

2.1.1 Finish Surfaces

Ensure all finished surfaces of FRP items and fabrications are smooth, resin-rich, free of voids and without dry spots, cracks, and un-reinforced areas. Completely cover glass fibers with resin to protect against their exposure due to wear or weathering. Stiles, rails, heads, jambs, and internal reinforcement shall be integrally pigmented.

2.1.2 Ultraviolet Protection

Provide documentation that pultruded structural shapes are further protected from ultraviolet (UV) attack with:

- a. Integral UV inhibitors within the resin
- b. Synthetic surfacing veil to help produce a resin rich surface
- c. UV-resistant coating for outdoor exposures.

2.1.3 Flame Spread Rating

All FRP products to have a flame spread rating of 25 or less as per ASTM E84 Tunnel Test.

2.1.4 Structural Properties

Meet minimum longitudinal structural properties with structural shapes in the door and frame system as follows:

Tensile Strength:	ASTM D638	30,000 psi
Compressive Strength:	ASTM D695	30,000 psi
Flexural Strength:	ASTM D790	30,000 psi
Flexural Modulus:	ASTM D790	1,600,000 psi
Short Beam Shear:	ASTM D2344/D2344M	4,500 psi
Impact, Notched:	ASTM D256	25 ft-lb/in
Thermal Expansion:	ASTM D696	.000008 in/in/F
Fire Resistance:	ASTM E84	Class I

2.2 DESIGN REQUIREMENTS

2.2.1 FRP Door and Frame

Provide complete swing-type FRP doors with frames of the size, design and location indicated, including but not limited to, framing members, subframes, door light, and accessories.

For related requirements for door hardware, refer to Section 08 71 00 DOOR HARDWARE.

2.2.1.1 FRP Door

Provide and install seamless press-molded constructed FRP doors. Laminate FRP face sheets to be applied while wet and uncured to an internal door stile and rail subframe/core assembly which is pressure molded under heat. Integrally fuse the composite door panel over the entire surface area, do not adhesive-bond at the perimeter stile and rail.

Provide door stiles and rails which are high-modulus pultruded FRP square or rectangular tube subframe. Miter and join tubes internally at the corners with solid polymer blocks to yield a one piece unit. Provide a mid-rail tube across the width of the door at lockset height and additional horizontal rails where specified. Chemically weld connections.

Provide a triangular-shaped 3/8 inch phenolic resin impregnated kraft paper honeycomb cell core for maximum rigidity and compressive strength. Polyurethane foam or balsa wood cores are not permitted.

Provide internal reinforcement composed of high-modulus pultruded tubular FRP or high-density polymer compression blocks at hardware and corner locations. Aluminum, steel, or wood blocking for reinforcement are not

permitted. A minimum pull-out force strength of 900 lbs per screw is required for hinge locations.

Door faces are to utilize a chemical resistant thermosetting polyester resin with fiberglass reinforcing layers. Provide structural reinforcement which is knitted multi-layer material with layers of unidirectional fiberglass orientated in both vertical and horizontal directions for high stiffness, impact and warp resistance. Furnish door faces as indicated by the door elevation drawings.

The exposed finish of the FRP door faces shall be an ultra-violet light stabilized marine grade Neopentyl Glychol (NPG)-isophthalic polyester gelcoat integrally molded to a wet thickness of 25/30 mil.

Cutouts for door lights and louvers are to be manufactured and not field fabricated. Cutouts are to be totally enclosed by internal pultruded FRP stiles and rails as specified and incorporated into the door subframe with the opening completely fused to both door faces.

2.2.1.2 FRP Frames

Provide FRP Door Frames utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 3/16 inch. Frames shall be one-piece, factory-constructed, with molded stops. Jambs and headers utilizing miter corner connections chemically welded with FRP material ground for a visibly smooth frame face. Post and beam or mechanically fastened corners and joints are not acceptable.

Provide hardware reinforcement connections utilizing a chemical weld with FRP material at required locations. A minimum pull-out force strength of 1,100 lbs per screw is required for all hardware locations.

Frame finish shall be door color and finish.

2.2.2 Fire-Rated Labeled FRP Door

Provide Fire-Rated Door Assemblies with indicated ratings complying with NFPA 80 and UL Fire Resistance that are listed and labeled by a qualified testing agency such as Underwriters Laboratories (UL) or base the door testing according to NFPA 252 or UL 10B. Ensure door labels are permanently affixed at the factory to the hinge edge of the door and do not paint.

Provide seamless press-molded constructed FRP doors. Laminate FRP face sheets to be applied while wet and uncured to an internal door stile and rail subframe/core assembly which is pressure molded under heat. Integrally fuse the composite door panel over the entire surface area; do not adhesive-bond at the perimeter stile and rail.

Ensure door is provided with a fire resistant mineral core for maximum rigidity and compressive strength. Molding pressure and resin gel time shall be sufficient to allow for full penetration of resin into the cellular structure of the core to maximize shear and peel strengths at the door faces and core to reduce the possibility of delamination. Verify that the mineral core has been completely enclosed with an intumescent and FRP- laminated edge perimeter, with the intumescent molded into the FRP door structure with a minimum 1/8 inch thick perimeter FRP edge banding prior to machining. Only Category A type door construction is permitted. Category B type construction with exposed edge intumescent components or

products is prohibited.

Hardware reinforcement to be high-modulus pultruded tubular FRP or high-density polymer compressions blocks at all hardware and corner locations. No aluminum, steel, or wood blocking for reinforcement is permitted. A minimum pull-out force strength of 1,100 lbs per screw is required for hinge locations.

Door faces shall utilize a chemical resistant thermosetting polyester resin formulated for the specified environment with a maximum flame spread of 25 in accordance with ASTM E84, and be self-extinguishing in accordance with ASTM D635 with fiberglass reinforcing layers. Provide structural reinforcement of knitted multi-layer material with layers of unidirectional fiberglass orientated in both vertical and horizontal directions for high stiffness, impact and warp resistance. Furnish door faces as indicated by the door elevation drawings.

Ensure the exposed finish of the FRP door faces with an ultra-violet light stabilized marine grade Neopentyl Glychol (NPG)-isophthalic polyester gelcoat integrally molded to a wet thickness of 25/30 mil.

2.2.3 Fire-Rated Labeled FRP Frame

Provide Fire-Rated Door Frames with indicated ratings complying with NFPA 80 that are listed and labeled by Underwriters Laboratories (UL). Permanently affix frame labels, at the factory, to the hinge side of the door jamb. Do not paint.

Provide Fire-Rated Door Frames utilizing a high-modulus pultruded structural FRP shape. Fabricate pultruded frame with a wall thickness of not less than 3/16 inch. Provide one-piece, factory-constructed frames with molded stops. Utilize miter connections between door jambs and header schemically welded with FRP material and ground for a visibly smooth frame face. Post-and-beam or mechanically fastened corners and joints are not acceptable.

Provide a minimum density of 25 pounds per cubic foot fire resistant composite formulated core for the specified environment with a maximum flame spread of 25 in accordance with ASTM E84, and self-extinguishing as per ASTM D635.

Frame finish shall match door color and finish.

2.2.4 Provisions for Glazing

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.2.4.1 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 60 minute rating when tested in accordance with ASTM E119. Glass shall be permanently labeled with appropriate markings.

2.2.4.2 Tempered Glass

ASTM C1048, fully tempered (FT), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3. Color shall be clear. Provide whenever

indicated or specified.

2.2.5 Frame Anchors

Provide anchorage devices and fasteners where necessary for fastening fabricated FRP door frame to the adjacent construction-in-place as recommended by the FRP frame manufacturer.

2.2.6 Jamb Anchors

Provide Masonry Anchors of corrosive-resistant hot-dip galvanized steel T-shaped minimum of 18 gauge thick.

Provide hot-dip galvanized steel Stud-Wall Type anchors design to engage the cold-formed steel wall framing; not less than 18 gauge thick.

2.3 HARDWARE PREPARATION

Provide hardware reinforcing as specified. Prepare doors and frames for hardware in accordance with the applicable requirements of FRP door and frame manufacturer. For additional requirements refer to ANSI/BHMA A156.115.

2.4 PERFORMANCE REQUIREMENTS

2.4.1 Provisions for Thermal Movement

Design doors and frames to accommodate expansion and contraction of the component parts caused by an ambient temperature range of 0 to 100 degrees F without causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

PART 3 EXECUTION

3.1 INSTALLATION

Conform all work to the requirements of 29 CFR 1910, 29 CFR 1926, and NFPA 241.

3.1.1 FRP Frame

Set FRP door frame plumb and true, aligned, and securely anchored in conformance with ASTM E2112. Anchor frame as specified and in accordance with the FRP door manufacturer's requirements.

Installation Tolerances

- a. Squareness: Plus or minus 1/16 inch, measure at the door rabbet on a line 90 degrees from the jamb perpendicular to the frame head.
- b. Alignment: Plus or minus 1/16 inch, measure at the jamb on a horizontal line parallel to the wall plane.
- c. Twist: Plus or minus 1/16 inch, measure at the opposite face corners of the jambs on parallel lines, and perpendicular to the wall plane.
- d. Plumb and True: Plus or minus 1/16 inch, measure at the jambs to the floor.

3.1.2 FRP Door

Fit and hang door in accordance with clearances specified below:

Clearance Tolerances

- a. Jambs and Head: Plus 1/8 inch or minus 1/16 inch.
- b. Bottom of Door and Top of Threshold: Maximum 3/8 inch.
- c. Bottom of Door and Top of finish floor (No Threshold): Maximum 3/8 inch.

3.1.3 Labeled Door and Frame

Install fire-rated door and frame, including hardware, in accordance with NFPA 101.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to final completion and acceptance of the project or replace with new, as directed by the Contracting Officer. Thoroughly clean surfaces of the door and frame prior to final completion and acceptance of the project.

3.3 ADJUSTMENT

Check and re-adjust all operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including FRP that is warped, bowed, or otherwise unacceptable to the Contracting Officer.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
08/08

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E283 (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1 (2013) Butts and Hinges
ANSI/BHMA A156.13 (2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16 (2013) Auxiliary Hardware
ANSI/BHMA A156.18 (2012) Materials and Finishes
ANSI/BHMA A156.21 (2009) Thresholds
ANSI/BHMA A156.4 (2013) Door Controls - Closers
ANSI/BHMA A156.6 (2010) Architectural Door Trim
ANSI/BHMA A156.7 (2003; R 2009) Template Hinge Dimensions
BHMA A156.15 (2011) Release Devices Closer Holder, Electromagnetic and Electromechanical
BHMA A156.22 (2012) Door Gasketing and Edge Seal Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8 (2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (2012) Building Materials Directory

1.2 SUBMITTALS

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

Hardware schedule; G

Keying system; G

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

Warranty; G

SD-11 Closeout Submittals

Key Bitting; G

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- a. Complete listing of all keys (AA1, AA2, etc.).
- b. Complete listing of all key cuts (AA1-123456, AA2-123458).

- c. Tabulation showing which key fits which door.
- d. Copy of floor plan showing doors and door numbers.
- e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.5.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE-RATED DOORS

Provide hardware necessary to meet the requirements of NFPA 80 for fire-rated doors. Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, locks, latches and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 4-1/2 by 4-1/2 inch. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install levers and roses of mortise locks with screwless shanks and no exposed screws.

2.3.3 Cylinders and Cores

Provide cylinders for locks. Provide fully compatible cylinders with products of the Best Lock Corporation with interchangeable cores which are removable by a special control key. Provide cylinders and cores with seven pin tumblers. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

2.3.4 Keying System

Provide an extension of the existing keying system. Existing locks were manufactured by Best Lock Corporation, seven pin, and have interchangeable cores.

Provide uncombined interchangeable cores compatible with the TE keyway and uncut key blanks in the A2 systems format as manufactured by the Best Lock Corporation. Cores and key blanks shall be delivered to the Contracting Officer within 90 days of the beginning of construction.

2.3.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.5.1 Lever Handles

Provide lever handles. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.6 Keys

Furnish two control keys for removable cores. Furnish 20 key blanks with an additional 20 percent of the total number. Stamp each key with appropriate key control symbol and "U.S Property - Do Not Duplicate." Do not place room number on keys. The Best Lock part number for the key blanks is "1A1TE1-KS112-KS800 operating key."

2.3.7 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.7.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.8 Magnetic Closer Holder-Release Devices

BHMA A156.15. Integrate with fire alarm system. Refer to Section 28 31 63.00 20 ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM.

2.3.8.1 Extension Rod

Adjustable extension rod.

2.3.9 Door Protection Plates (Kick Plates)

ANSI/BHMA A156.6.

2.3.9.1 Sizes of Kick Plates

2 inch less than door width by 8 inches tall.

2.3.10 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door.

2.3.11 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, thermally broken.

2.3.12 Weatherstripping Gasketing

BHMA A156.22. Provide sets to include head and jamb seals and sweep strips. Air leakage of weatherstripped doors shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283.

2.4 FASTENERS

Provide stainless steel fasteners of proper type, quality, size, quantity, and finish with hardware. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel). Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers. Provide hinges in stainless steel with BHMA 630 finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation

instructions. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Handle and install weatherstripping to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with countersunk, stainless steel screws in expansion sleeves.

3.2 FIRE-RATED DOORS

Install hardware in accordance with NFPA 80 for fire doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick Plates: Push side of single-acting doors.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS

HARDWARE SET NO. 1 (Door 401 - Exterior Single Door)

No.	Item	Notes
3	Hinges	BHMA A5111
1	Closer	BHMA C02021
1	Lockset	ANSI Type F01
1	Threshold	
1	Weatherstripping	
1	Kickplate	BHMA J102 Stainless Steel

HARDWARE SET NO. 2 (Doors 101, 201, 301, 301A - Interior Single Door)

No.	Item	Notes
3	Hinges	BHMA A5111
1	Closer	BHMA C02021
1	Magnetic Hold Open	Door Holder Extension Rod at Door 201
1	Lockset	ANSI Type F01
1	Kickplate	BHMA J102 Stainless Steel
1 set	Silencers	

HARDWARE SET NO. 3 (Door 002 - Interior Single Door)

No.	Item	Notes
3	Hinges	BHMA A5111
1	Closer	BHMA C02021
1	Lockset	ANSI Type F09
1	Threshold	
1	Doorstop	
1 set	Weatherstripping	
1	Kickplate	BHMA J102 Stainless Steel

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS

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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D (2012) Laboratory Methods of Testing
Dampers for Rating

AMCA 511 (2013) Certified Ratings Program for Air
Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2011) Voluntary Specification,
Performance Requirements and Test
Procedures for Superior Performing Organic
Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM B209 (2010) Standard Specification for Aluminum
and Aluminum-Alloy Sheet and Plate

ASTM B221 (2013) Standard Specification for Aluminum
and Aluminum-Alloy Extruded Bars, Rods,
Wire, Profiles, and Tubes

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

Wall louvers, including anchorage details; G

SD-03 Product Data

Metal Wall Louvers, including wind load, air performance and water
penetration ratings; G

SD-04 Samples

Wall louvers color charts; G

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louvers shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with insect screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounces per square foot of free area at a free velocity of 800 feet per minute. Louver shall be drainable.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Screens and Frames

Provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum insect screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces shall be factory finished with an organic coating. Color shall be as selected by the Contracting Officer from the manufacturer's full range of standard colors.

2.4.1.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mil, color shall be selected from manufacturer's standard colors.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum louver surfaces contact metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.2 Metal

Paint metal louver surfaces in contact with concrete with alkali-resistant coatings such as heavy-bodied bituminous paint recommended by louver manufacturer.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD

05/11

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1047	(2010a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1629/C1629M	(2006; R 2011) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	(2012) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C840	(2013) Application and Finishing of Gypsum Board
ASTM C954	(2011) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D2394	(2005; R 2011) Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D5420	(2010) Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM E695	(2003; R 2009) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board
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Finish

GA 216

(2010) Application and Finishing of Gypsum
Panel Products

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

Impact Resistant / Moisture Resistant Gypsum Board; G

Accessories

Joint Treatment Materials; G

Submit manufacturer's product data, indicating VOC content.

SD-07 Certificates

Asbestos Free Materials; G

Certify that gypsum board and joint treatment materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer maintenance instructions

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Gypsum wallboard shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.3.3 Handling

Neatly stack gypsum board flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board.

1.4.2 Exposure to Weather

Protect gypsum board products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.4.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.5 SCHEDULING

Do not install gypsum board until metal roof and wall panel systems, louvers, and doors have been installed, tested, and accepted.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types and joint treating materials manufactured from asbestos free materials only. Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials.

2.1.1 Impact Resistant / Moisture Resistant Gypsum Board

48-inch wide, 5/8-inch-thick, tapered edges. Reinforce gypsum panel with embedded fiber mesh or lexan backing tested in accordance with the following tests: Hard body impact test must attain a Level 3 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant / moisture resistant gypsum board, when tested in accordance with ASTM E84, have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2.1.1.1 Structural Failure Test

ASTM E695 or ASTM D2394 for structural failure (drop penetration). ASTM E695 using a 60lb, sand-filled, leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.1.2 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once from 3 feet creating not more than 0.137 inch indentation or ASTM D1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.2 Joint Treatment Materials

ASTM C475/C475M. Use all-purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.2.1 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.2.2 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.2.3 Joint Tape

Use cross-laminated, tapered edge, fiber glass mesh tape recommended by the manufacturer.

2.1.3 Fasteners

2.1.3.1 Screws

ASTM C954 corrosion resistant steel drill screws for fastening gypsum board to steel framing members.

2.1.4 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.5 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board. Verify that blocking, headers and supports are in place to support railings and other items mounted to gypsum board surfaces. Do not proceed with work until framing and furring are acceptable for application of gypsum board.

3.2 CONTROL JOINTS

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216.

3.2.1 Application of Impact Resistant / Moisture Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish walls and ceilings to Level 4 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Use setting or hardening type joint compounds. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust; cover louvers, floor drain, and door openings prior to sanding. Vacuum dust..

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board.

3.5 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- End of Section --

SECTION 09 67 23.13

STANDARD RESINOUS FLOORING (OPTION 4)

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 D2370	(1998; R 2010) Tensile Properties of Organic Coatings
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4060	(2010) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4541	(2009; E 2010) Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D790	(2010) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2012; Amendment 1 2012) Life Safety Code
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U.S. DEPARTMENT OF DEFENSE (DOD)

MIL D-24613	Deck Covering Materials, Interior, Cosmetic Polymeric
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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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data including performance data and installation procedures; G

Manufacturer's MSDS for each product being used.

High performance resinous flooring system; G

SD-04 Samples

High performance resinous flooring system; G

Submit a 6-inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system.

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 60 and 90 degrees F.

1.4 QUALITY ASSURANCE

Manufacturer shall have a minimum of 10 years experience in the production, sales and technical support of resinous flooring and related materials.

System shall be in compliance with requirements of USDA, FDA, and local health department.

A pre-installation conference shall be held between Applicator, Contractor, and the Contracting Officer for review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria, and production schedule.

PART 2 PRODUCTS

2.1 HIGH PERFORMANCE RESINOUS FLOORING SYSTEM

High performance resinous flooring system to consist of the following materials:

a. System

1. Primer: Resin and hardener.
2. Broadcast Coats: Resin and hardener.
3. A colored quartz aggregate.
4. Grout Coat: Resin and water clear hardener.
5. Resin and hardener.

b. System Characteristics

1. Color and Pattern: As indicated on drawings.

2. Slip Resistance: Provide slip resistant finish.

c. Patch Materials

1. Shallow fill and patching.
2. Deep fill and sloping materials (over 1/4 inch).

2.2 PRODUCT REQUIREMENTS

- | | |
|--|---|
| a. Primer | Dur-A-Shield #4 or Approved Equal |
| 1. Percent Solids | 100% |
| 2. VOC | 3.8 g/L |
| 3. Bond Strength to Concrete
ASTM D4541 | 400 psi, substrates fails |
| 4. Compressive Strength,
ASTM D695 | 11,200 psi |
| 5. Tensile Strength, ASTM D638 | 2,100 psi |
| 6. Flexural Strength, ASTM D790 | 5,100 psi |
| 7. Abrasion Resistance,
ASTM D4060 C-10 Wheel,
1,000 gm load, 1,000cycles | 29 mg loss |
| 8. Flame Spread/NFPA 101,
ASTM E84 | Class A |
| 9. Impact Resistance MIL D-24613 | 0.0007 inches, no cracking or
delamination |
| 10. Water Absorption, MIL D-24613 | Nil |
| 11. Potlife @ 70 F | 20 minutes |
| b. Broadcast Coat and Grout Coat | Dur-A-Glaze #4 or Approved Equal |
| 1. Percent Solids | 100% |
| 2. VOC | 3.8 g/L |
| 3. Compressive Strength,
ASTM D695 | 11,200 psi |
| 4. Tensile Strength, ASTM D638 | 2,100 psi |
| 5. Flexural Strength, ASTM D790 | 5,100 psi |
| 6. Abrasion Resistance,
ASTM D4060 C-10 Wheel,
1,000 gm load, 1,000 cycles | 29 mg loss |
| 7. Flame Spread/NFPA 101,
ASTM E84 | Class A |
| 8. Impact Resistance MIL D-24613 | 0.0007 inches, no cracking or
delamination |
| 9. Water Absorption, MIL D-24613 | Nil |
| 10. Potlife @ 70 F | 20 minutes |
| c. Topcoat | Armor Top or Approved Equal |
| 1. Percent Solids | 95% |
| 2. VOC | 74 g/L |
| 3. Tensile Strength, ASTM D2370 | 7,000 psi |
| 4. Adhesion, ASTM D4541 | Substrate Failure |
| 5. Hardness, ASTM D3363 | 4H |
| 6. 60 deg Gloss ASTM D4060 | 70 |
| 7. Abrasion Resistance,
ASTM D4060 CS 17 Wheel
(1,000 g load) 1,000 cycles | 14 mg loss |
| 8. Potlife, 70 F, 50% RH | 2 Hour |

2.2.1 Vapor Mitigating System

As recommended by manufacturer.

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. Refer to Section 01 50 00.00 22 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS (PWD ME) for dust proof partition requirements.

Accomplish shot and 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 General

- a. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
- b. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
- c. Mechanical surface preparation.
 1. Shot blast surfaces to receive flooring system with a mobile steel shot, dust recycling matching (Blastrac or approved equal). Surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
 2. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 3. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.

4. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.

3.3 APPLICATION

3.3.1 General

- a. The system shall be applied in seven distinct steps as listed below:
 1. Substrate preparation.
 2. Vapor mitigation system.
 3. Priming.
 4. First broadcast coat application with first aggregate broadcast.
 5. Second broadcast coat with second aggregate broadcast.
 6. Grout coat application, sand floor (if required).
 7. Topcoat application.
- b. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum.
- c. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
- d. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified or indicated.
- e. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

3.4 APPLICATION

3.4.1 Primer

- a. The primer shall consist of a liquid resin and hardener that is mixed at the ratio of 2 parts resin to 1 part hardener per the manufacturer's instructions.
- b. The primer shall be applied by flat squeegee and back rolled at the rate of 200-250 sf/gal to yield a dry film thickness of 6 mils.

3.4.2 Broadcast Coat

- a. The broadcast coat shall be applied as a double broadcast system.
- b. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
- c. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
- d. The broadcast coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
- e. Colored quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs/sf.
- f. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
- g. Apply a second coat of resin with a coverage rate of 90-100 sf/gal and broadcast aggregate to excess at the rate of 0.5 lbs/sf.
- h. Allow material to fully cure. Vacuum and sweep to remove all loose aggregate.

3.4.3 Grout Coat

- a. The grout coat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of 1 part hardener to 2 parts resin and installed per the manufacturer's recommendations.
- b. The grout coat shall be squeegee applied and back rolled with a coverage rate of 90-100 sf/gal.

3.4.4 Topcoat

- a. The topcoat shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
- b. The topcoat shall be comprised of a liquid resin, hardener and grit that is mixed per the manufacturer's instructions.
- c. The finish floor shall have a nominal thickness of 1/8 inch.

3.5 FIELD QUALITY CONTROL

3.5.1 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.

The Applicator shall conduct the following inspection tests:

- a. Temperature: Air and substrate temperatures and dewpoint (if applicable).
- b. Coverage Rates: Rates for all layers shall be monitored by checking quantity of material used against area covered.

3.6 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.

Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.

Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS

05/11

PART 1 GENERAL

1.1 RELATED SECTIONS

This section includes coatings for items not indicated in Section 09 97 13.00 40 STEEL COATINGS.

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 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 D4214 (2007) Standard Test Method for Evaluating
the Degree of Chalking of Exterior Paint
Films

ASTM D4263 (1983; R 2012) Indicating Moisture in
Concrete by the Plastic Sheet Method

ASTM D523 (2014) Standard Test Method for Specular
Gloss

ASTM D6386 (2010) Standard Practice for Preparation
of Zinc (Hot-Dip Galvanized) Coated Iron
and Steel Product and Hardware Surfaces
for Painting

ASTM F1869 (2011) Measuring Moisture Vapor Emission
Rate of Concrete Subfloor Using Anhydrous
Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 101 (Oct 2009) Epoxy Anti-Corrosive Metal
Primer

MPI 107 (Oct 2009) Rust Inhibitive Primer
(Water-Based)

MPI 108 (Oct 2009) High Build Epoxy Coating, Low
Gloss

MPI 11 (Oct 2009) Exterior Latex, Semi-Gloss, MPI
Gloss Level 5

MPI 134	(Oct 2009) Galvanized Primer (Waterbased)
MPI 141	(Oct 2009) Interior High Performance Latex MPI Gloss Level 5
MPI 151	(Oct 2009) Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	(Oct 2009) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 163	(Oct 2009) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 4	(Oct 2009) Interior/Exterior Latex Block Filler
MPI 47	(Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
MPI 95	(Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01	(2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC Guide 6	(2004) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC Guide 7	(2004; E 2004) Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating

SSPC SP 2	(1982; E 2000; 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 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. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings
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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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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

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:

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

Coatings; G

Manufacturer's Technical Data Sheets

Indicate VOC content.

Paint schedule indicating surface preparation methods, products/systems and location. Cross reference paint tables included in this specification.

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

Physical samples demonstrating finish color and tinted intermediate coats.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings; G

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings; G

Preprinted cleaning and maintenance instructions for each coating system.

Paint schedule with selected color.

1.4 APPLICATOR'S QUALIFICATIONS

1.4.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

- a. Name of individual and proposed position for this work.
- b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.5 QUALITY ASSURANCE

1.5.1 Field Samples and Tests

As part of Option 4, the Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

Another required testing is Batch Quality Conformance Testing to prove conformance of the manufacturer's paint to the specified MPI standard. This testing is accomplished before the materials are delivered to the job site. Test paint products as specified in the paragraph "Testing Procedure".

1.5.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.5.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.6 REGULATORY REQUIREMENTS

1.6.1 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.2 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.3 Asbestos Content

Materials shall not contain asbestos.

1.6.4 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.6.5 Silica

Abrasive blast media shall not contain free crystalline silica.

1.6.6 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.7 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. Do not store paint products with materials that have a high capacity to adsorb VOC emissions. Do not store paint products in occupied spaces.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26.00 22 GOVERNMENTAL SAFETY REQUIREMENTS (PWD ME) and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

Maintain a copy of MSDS sheets on site and readily accessible.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH 0100, threshold limit values.
- d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 02 83 13.00 22 LEAD IN CONSTRUCTION (PWD ME). Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to Section 02 83 13.00 22 LEAD IN CONSTRUCTION (PWD ME) for drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 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 violate manufacturer recommendations.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application, whichever is longer:

- 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 85 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.

1.10 COLOR SELECTION

Colors of finish coats shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats. Submit physical sample of coating system on 12 inch square substrate to be coated or substitute material approved by Contracting Officer. Sample shall use selected color and include tinted intermediate coats. Offset each coat a minimum of 2 inches. Provide sample for each system and color as directed by the Contracting Officer.

Color, texture, and pattern of wall coating systems shall be as indicated.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 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.

1.11.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.11.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Steel to be embedded in concrete.
- c. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
- d. Hardware, fittings, and other factory-finished items except as noted above.

1.11.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
 - (1) Exposed piping, conduit, and ductwork;
 - (2) Supports, hangers, air grilles, and registers;
 - (3) Miscellaneous metalwork and insulation coverings.

1.11.4 Definitions and Abbreviations

1.11.4.1 Qualification Testing

Qualification testing is the performance of test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.11.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.11.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.11.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.11.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.11.4.7 EXT

MPI short term designation for an exterior coating system.

1.11.4.8 INT

MPI short term designation for an interior coating system.

1.11.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.11.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.11.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.11.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.11.4.14 Paint

See Coating definition.

1.11.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.11.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.11.5 Paint Schedule

Submit a paint schedule that indicates each unique surface location to be painted and includes each proposed surface preparation method, coating

system constituents with dry film thicknesses, application methods, and safety and environmental methods. Include color selections. Resubmit at closeout with operations and maintenance data.

PART 2 PRODUCTS

2.1 COATINGS

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, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

- a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.
- b. Wipe previously painted surfaces to receive solvent-based coatings. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.
- c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.
- d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

- e. Previously painted surfaces specified to be repainted or damaged during construction shall be thoroughly cleaned of grease, dirt, dust or other foreign matter.
- f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.
- g. Chalk shall be removed so that when tested in accordance with ASTM D4214, the chalk resistance rating is no less than 8.
- h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.
- i. Edges of chipped paint shall be feather edged and sanded smooth.
- j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.
- k. Provided coatings shall be compatible with existing coatings.

3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding or blasting so that when tested in accordance with ASTM D4214, the chalk rating is not less than 8.

3.2.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

- a. Surfaces containing large areas of minor defects;
- b. Surfaces containing more than 20 percent peeling area; and
- c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.2.4 Substrate Repair

- a. Repair substrate surface damaged during coating removal;
- b. 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 6/NACE No.3. 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 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 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.
- c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12/NACE No.5 WJ3 degree of cleanliness. Spot abrasive blast rusted areas as described for steel in SSPC SP 6/NACE No.3, and waterjet to SSPC SP 12/NACE No.5, WJ3 to remove existing coating.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

- a. Curing: Concrete and masonry surfaces shall be allowed to cure at least 30 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
 - (1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate,

1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

a. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263.

3.5 APPLICATION

3.5.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush or roller. 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.

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 edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.5.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.5.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3.	Exterior Concrete Paint Table
Division 5.	Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 3.	Interior Concrete Paint Table
Division 4.	Interior Concrete Masonry Units Paint Table
Division 5.	Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 9:	Interior Gypsum Board 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.

3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged

coatings to protect from rusting prior to applying field primer.

- d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.
- e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3 for Exterior and Divisions 3, 4 and 9 for Interior.

3.8 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including doors for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.9 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

3.10 PAINT TABLES

All DFT's are minimum values. Use only materials with a GPS green check mark having a minimum MPI "Environmentally Friendly" E2 or E3 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at <http://www.specifygreen.com/APL/ProductIdxByMPInum.asp>.

3.10.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

- A. New and uncoated existing and Existing, previously painted concrete; vertical surfaces, including undersides of soffits but excluding tops of slabs:

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

1. Latex

New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 11 MPI 11 MPI 11
System DFT: 3.5 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

Provide coating system No. 2 as specified in Section 09 97 13.00 40 STEEL COATINGS.

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

Provide coating system No. 2 as specified in Section 09 97 13.00 40 STEEL COATINGS.

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

Provide coating system No. 2 as specified in Section 09 97 13.00 40 STEEL COATINGS.

C. Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3:

Provide coating system No. 2 as specified in Section 09 97 13.00 40 STEEL COATINGS.

1. Surface previously coated with epoxy:

Waterborne Light Industrial
a. MPI REX 5.1L-G5 (Semigloss)
Spot Primer: Intermediate: Topcoat:
MPI 101 MPI 163 MPI 163
System DFT: 5 mils

EXTERIOR GALVANIZED SURFACES

A. New Galvanized surfaces:

1. Waterborne Primer / Waterborne Light Industrial Coating

MPI EXT 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 163 MPI 163
System DFT: 4.5 mils

B. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating

MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 163

EXTERIOR GALVANIZED SURFACES

System DFT: 4.5 mils

G. Galvanized surfaces with severely deteriorated coating or rusting:

1. Waterborne Light Industrial Coating

MPI REX 5.3L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 163

System DFT: 8.5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

A. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Waterborne Light Industrial Coating

MPI EXT 5.4G-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 163	MPI 163

System DFT: 5 mils

B. Surfaces adjacent to painted surfaces; mechanical, electrical, fire extinguishing sprinkler systems including valves, conduit, hangers, supports, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish.

1. Waterborne Light Industrial Coating

MPI EXT 5.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 163	MPI 163

System DFT: 5 mils

3.10.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing and Existing, previously painted Concrete in high-humidity areas not otherwise specified except floors:

1. Waterborne Light Industrial Coating

New; MPI INT 3.1L-G3(Eggshell) / Existing; MPI RIN 3.1C-G3(Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 3	MPI 151	MPI 151

System DFT: 4.8 mils

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry units in high humidity areas unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 151	MPI 151

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

System DFT: 11 mils

Fill all holes in masonry surfaces.

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, mechanical, electrical, fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex

MPI INT 5.1R-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 79 MPI 141 MPI 141

System DFT: 5 mils

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations:

1. Waterborne Light Industrial Coating

MPI INT 5.1B-G6 (Gloss)

Primer: Intermediate: Topcoat:

MPI 107 MPI 151 MPI 151 (plus NSA)

System DFT: 5.25 mils

C. Metal in high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd

MPI INT 5.1E-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 79 MPI 47 MPI 47

System DFT: 5.25 mils

D. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex

MPI INT 5.4F-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 95 MPI 141 MPI 141

System DFT: 5 mils

DIVISION 9: INTERIOR GYPSUM BOARD PAINT TABLE

A. New Gypsum Board in high humidity areas not otherwise specified:

1. Waterborne Light Industrial Coating

New; MPI INT 9.2L-G5 (Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer: Intermediate: Topcoat:

DRY DOCK #3 PUMP WELL REPAIRS
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

1332591

DIVISION 9: INTERIOR GYPSUM BOARD PAINT TABLE
MPI 50 MPI 153 MPI 153
System DFT: 4 mils

-- End of Section --

SECTION 09 97 13.00 40

STEEL COATINGS

07/07

PART 1 GENERAL

Coating System No. 1 shall be used for exposed bolts that are cut as part of the project and will remain exposed.

Coating System No. 2 shall be used for pipe repairs.

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.

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC AB 1	(2013) Mineral and Slag Abrasives
SSPC Painting Manual	(2002) Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted in accordance with paragraph entitled, "General," of this section.

A Safety Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Inorganic Zinc; G

Inhibitive Polyamide Epoxy; G

Aliphatic Polyurethane; G

Blast Cleaning Collection System; G

SD-06 Test Reports

Inspection Forms; G

Shall be submitted in accordance with paragraph entitled, "Inspection," of this section.

SD-07 Certificates

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Abrasive Blasting Material; G

Coating Systems; G

Inhibitive Polyamide Epoxy; G

Aliphatic Polyurethane; G

SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for Protective Coatings including details of thinning, mixing, handling, and application.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unopened containers bearing the manufacturer's name, shelf-life, product identification, and batch number.

Coatings, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will be protected from exposure to extreme cold or heat, sparks, flame, direct sunlight, or rainfall. Manufacturer's instructions for storage limitations shall be followed.

1.4 GENERAL

A Safety Plan shall be submitted for protective coating systems in accordance with OSHA regulations.

Material, Equipment, and Fixture Lists shall be submitted for manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

PART 2 PRODUCTS

2.1 ABRASIVE BLASTING MATERIAL

Abrasive blasting materials shall be per SSPC Painting Manual, Chapter 2.4, and SSPC AB 1.

2.2 PROTECTIVE COATINGS

2.2.1 Coating Systems

The following two coating systems definitions are to be specified for use on the surfaces shown on the drawings, and as directed by the Contracting Officer.

Coating System No. 1 shall consist of inorganic zinc only, no top coat unless specified. Products that are considered to meet those requirements include, but are not limited to the products included in Table 1 below. Coatings, thinners, and cleaners shall be the product of one manufacturer.

Coating System No. 2 shall consist of inorganic zinc first coat, inhibitive polyamide epoxy intermediate coat, and aliphatic polyurethane finish coat. Products that are considered to meet those requirements include, but are not limited to the products in Table 1 below. All coatings, thinners, and cleaners shall be the product of the same manufacturer. The color of the coating shall match the existing coating system.

Table 1 - COATING SYSTEMS			
<u>INORGANIC ZINC</u>	<u>INHIBITIVE POLYAMIDE EPOXY</u>	<u>ALIPHATIC POLYURETHANE</u>	<u>MANUFACTURER</u>
Dimetcote 9	Amercoat 385	Amercoat 450HS	Ameron International 201 N. Berry Street Brea, CA 92621 714/529-1951
N/A	Carbomastuc 615 HS	Carbothane 133 HB	Carboline Company 350 Hanley Industrial Court St. Louis, MO 63144 800/848-4645 Ext. 2557
Cathacoat 304V	Bar-Rust 233H	Devthane 359	ICI-DEVOE 925 Euclid Ave. Cleveland, OH 44115 216/344-8798
GANICIN 3.4 IOZ	CORLAR 3.2 PR or CORLAR 2.1-PR	Imron 3.5HG	DuPont Company DuPont Building 1007 Market Street Wilmington, DE 19898 800/441-7515

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 General

Faying surfaces that will become inaccessible after installation shall be abrasive blasted and coated with inorganic zinc only, prior to

installation.

Prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Surfaces not coated within 6 hours or which show rusting or contamination, regardless of the length of time after preparation, shall be re-prepared.

Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

Surfaces shall be inspected and degreased as required prior to subsequent surface preparation and the application of protective coatings. Degreasing shall be by solvent cleaning, detergent washing, or steam cleaning. SSPC SP 1 shall apply for solvent cleaning.

3.1.2 Blast Cleaning

SSPC SP 10/NACE No. 2. After solvent cleaning, complete surface preparation by near-white blast cleaning. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. If a system with multiple coatings is used, the surfaces must be cleaned, including chloride removal, prior to application of each coat. Work areas where blast cleaning is to occur are to be fully contained so that grit and corrosion does not fall into the water. A suitable blast cleaning collection system shall be employed. Submit details of system for approval.

Remove existing coating to limits shown on the drawings. All interior blasting shall include full containment. Any damage to the existing equipment inside the pump well shall be the responsibility of the Contractor and shall be repaired or replaced at no additional cost to the Government.

3.1.2.1 Surface Profile

Blast surfaces to provide a 2-1/2 mil surface profile using steel grit. For boundary areas that may be overloaded, brush blast material off the existing surface to create a roughened surface. Expended grit shall not be permitted to fall into the water. Expended grit shall be captured by a suitable collection system and corrosion resistant materials placed beneath areas to be blasted. The grit and removed materials shall be transferred to the shore and disposed of properly.

Prior to coating, the Contractor, in the presence of the Contracting Officer, shall test 10% of each type of element cleaned to ensure the required surface profile has been achieved. Surface profile testing shall be performed per accepted SSPC procedures.

3.1.2.2 Air Dry

Blow down the surfaces using clean oil-free compressed air and sweep with clean, natural bristle brushes.

3.1.2.3 Chloride Testing

Test surfaces for chloride contamination with "Chlor*Test" product or equal. If present, wash with a super surfactant such as "Chlor*Rid" and water, then dry with oil-free compressed air.

3.1.3 Mechanical Cleaning (MC)

Needle scalers or abrasive disks or wheels shall be used in accordance with SSPC SP 3, leaving the surface cleanliness equivalent to near-white metal (SSPC SP 10/NACE No. 2).

3.2 COATING APPLICATION

3.2.1 General Requirements

Manufacturer's instructions for thinning, mixing, handling, and applying products shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs; sags; blisters; bubbles; mud cracking; variations in color, gloss, and texture; holidays (missed areas); excessive film build; foreign contaminants; and dry overspray.

No coating shall be applied when rain is imminent or when the temperature or humidity is outside the limits recommended by the coating manufacturer.

Surface temperature shall be at least 5 degrees F above the dew point.

Coatings shall be thoroughly worked into all joints, crevices, and open spaces. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

Newly coated surfaces shall be adequately protected from damage.

Coatings shall be applied by airless or conventional spray. Airless spraying shall be used for uniform large surface areas. Conventional spraying shall be used for small areas of intricate configuration and for touch-up. During application of inorganic zinc coating, maintain uniform suspension.

Existing coatings shall be feathered during removal on the ends to blend with coating system.

3.2.2 Mixing and Application Procedures

Material shall be stirred thoroughly using an instrument that will not induce air into coating.

Mixed material shall be strained through a 30- to 60-mesh screen.

Continuous slow agitation of the material shall be provided during application of inorganic zinc coating, maintain uniform suspension. Continuous rapid agitation shall be avoided.

Material shall be thinned for workability and improved spray characteristics only.

Material shall be applied in even, parallel passes, overlapping 50

percent. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

3.2.3 Dry-Film Thickness (DFT)

Coatings shall be applied to the following dry-film thicknesses:

Coating System No. 1:

- a. 3 to 6 mils, inorganic zinc
- b. Intermediate coat, inorganic zinc, 2 to 4 mils
- c. Second coat, inorganic zinc, 2 to 4 mils
- d. Top coat 2 to 4 mils

Coating System No. 2:

- a. Inorganic primer zinc: 2.5 to 4 mils
- b. Inhibitive polyamide epoxy, intermediate coat: 2 to 4 mils
- c. Aliphatic polyurethane, finish coat: 2 to 4 mils, but sufficient to hide previous coat

3.3 TOUCH-UP

Abrasions that occurred during shipment or erection shall be touched up as follows:

- a. Surface preparation and coating application shall conform to the manufacturer's instructions.
- b. Inorganic zinc shall be used for touch-up and repair of inorganic zinc and hot-dip galvanizing.
- c. Inhibitive polyamide epoxy and aliphatic polyurethane shall be used for touch-up and repair of coating system No. 2.

3.4 SEALANT COMPOUND APPLICATION

For Coating System No. 1, caulking shall be accomplished after application and cure of inorganic zinc coating.

For Coating System No. 2, caulking shall be accomplished after application and cure of inhibitive polyamide epoxy coat and prior to aliphatic polyurethane coat.

Exterior joints shall be caulked, including, but not limited to, the following:

- a. Perimeter of faying and bearing surfaces of structural members
- b. Joints in members between intermittent welds
- c. Perimeter of bearing surfaces between floor plates and supporting members (inside, outside, top, and bottom)

- d. Stair treads, where joined to channel stringers
- e. Openings of 1/2 inch or smaller (Foam filler backup shall be used as required.)
- f. Hot-dipped galvanized vent holes

3.5 INSPECTION

On-site work as described herein shall be inspected for compliance with this specification by a NACE (National Association of Corrosion Engineers) Certified Coating Inspector provided by the Contractor.

Inspection Forms shall be submitted at the pre-construction conference which shall be used by the Coating Inspector and forwarded to the Contracting Officer prior to delivery of the coated work to the job site.

3.5.1 Holiday Testing

After coating, test for holidays in total coating system. Use a low-voltage holiday detector of less than 90 volts in accordance with manufacturer's instructions. After repair of holidays by surface treatment and application of additional coating or by manufacturer's recommendations, retest with a low-voltage holiday detector. Contractor shall have available on-site a working, calibrated, electronic mil thickness tester, at all times.

-- 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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2008) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(1990; INT 2007) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2012) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units
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AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; ERTA 2012; S 2013) Load Ratings and Fatigue Life for Ball Bearings

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
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	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM E2016	(2011) Standard Specification for Industrial Woven Wire Cloth
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA DC 3	(2008) Residential Controls - Electrical Wall-Mounted Room Thermostats
NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2001; R 2007) 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 2014) National Electrical Code
NFPA 701	(2010) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

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. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82

Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 1995

(2011) Heating and Cooling Equipment

UL 586

(2009) Standard for High-Efficiency
Particulate, Air Filter Units

UL 6

(2007; reprint Nov 2010) Electrical Rigid
Metal Conduit-Steel

UL 705

(2004; Reprint Dec 2013) Standard for
Power Ventilators

UL 900

(2004; Reprint Feb 2012) Standard for Air
Filter Units

UL Bld Mat Dir

(2012) Building Materials 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 piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Dehumidifier Number	DH - 1A
Exhaust Fan Number	EF - 1A
Condenser Unit Number	CU - 1A

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; G
Duct Access Doors; G
Manual Balancing Dampers; G
Round Backdraft Dampers; G
Control Dampers and Actuators; G
Diffusers; G
Registers and Grilles; G
Louvers; G
In-Line Centrifugal Fans; G
Dehumidifiers With Remote Condenser Units; G
Electric Heating Coils; G
Thermostats; G
Humidistats; G
Sampling Sink; G

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions; G
Operation and Maintenance Training; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

In-Line Centrifugal Fans; G
Dehumidifiers With Remote Condenser Units; G
Electric Heating Coils; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

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.

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. Provide coastal corrosion protection that can withstand a salt spray test of at least 3,000 hours.

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, associated equipment shields for indicated units, 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. Refer to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS for equipment shields. 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.

1.5 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. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

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.

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 Stainless Steel Ductwork

Provide stainless steel ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

- a. 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.
- b. Provide ductwork that meets the requirements of Seal Class A.
- c. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least

2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

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-retardant fabrics" in UL Bld Mat Dir.

2.9.1.2 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167, Grade 316.

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 stainless steel manual balancing dampers with accessible operating mechanisms. 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.
- 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

Provide 316 stainless steel frames.

Width	Height	316 Stainless 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

Provide 316 stainless steel frames.

Width	Height	316 Stainless 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 316 stainless 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	316 Stainless Steel	Minimum 3/8 inch
More than 19 inches	Maximum 12 inches	316 Stainless Steel	Minimum 1/2 inch

2.9.3.1.1.4 Axle Bearings

Support the shaft on each end at the frames with 316 stainless steel 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	316 stainless steel
More than 19 inches	Maximum 12 inches	316 stainless steel

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

316 stainless steel.

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 316 stainless steel, minimum of 5 inches long.

2.9.3.1.2.3 Blades

Minimum of 16 gauge 316 stainless steel; 6 inch nominal width.

2.9.3.1.2.4 Blade Axles

To support the blades of round dampers, provide 316 stainless steel square 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 316 stainless steel. 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 316 stainless steel.

2.9.3.1.2.7 Blade Actuator Linkage

316 stainless steel bar and crank plate with 316 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

316 stainless steel.

2.9.3.2 Round Dampers

2.9.3.2.1 Frames

Provide 316 stainless steel frames.

Size	316 Stainless Steel Thickness	Length
4 to 20 inches	Minimum 20 gauge	Minimum 6 inches

2.9.3.2.2 Blades

Provide 316 stainless steel blades.

Size	Galvanized Steel Thickness
4 to 20 inches	Minimum 20 gauge

2.9.3.2.3 Blade Axles

To support the blades of round dampers, provide 316 stainless steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

Size	Shaft Size and Shape
4 to 20 inches	Minimum 3/8 inch square

2.9.3.2.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of 316 stainless steel. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

Size	Material
4 to 20 inches	316 stainless steel

2.9.3.2.5 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.

2.9.3.2.6 Finish

316 stainless steel.

2.9.4 Round Backdraft Dampers

Provide round backdraft dampers with a pressure rating of 3 inches of water column. Damper frame shall be 20 gauge, 304 stainless steel. Blades shall be 24 gauge, 304 stainless steel. Blade seal shall be closed cell neoprene/EPDM/SBR blend.

2.9.5 Control Dampers

Provide factory manufactured 316 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 316 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 2,000 fpm air velocity. The pressure drop through each damper when full-open shall not exceed 0.04 inches water gage at 1,000 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 316 stainless steel.

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.

2.9.5.1 Electric Control Damper 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. 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. Spring return actuators shall be provided on all control dampers. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

2.9.6 Diffusers, Registers and Grilles

Provide factory-fabricated units with capacities and characteristics as scheduled. 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. Provide opposed blade type volume dampers for diffusers and registers where indicated.

2.9.7 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL LOUVERS.

2.9.8 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the

fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.10.1.1 In-Line Centrifugal Fans

Provide in-line fans with welded airfoil centrifugal wheel, stationary discharge straightening vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular steel casing. Provide a fan that axially flows the air in and out. Streamline inlets with straightening vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide motors with open dripproof enclosure. Entire unit shall be sprayed with manufacturer's premium corrosion resistant polyester coating.

2.10.2 Coils

2.10.2.1 Electric Heating Coils

Provide an electric duct heater coil in accordance with UL 1995 and NFPA 70. Provide duct-mounted coil. Provide nickel chromium resistor, single stage, strip or stainless steel, fin tubular type coil. Provide coil with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Provide stainless steel coil casing and support brackets. Mount coil to eliminate noise from expansion and contraction and for complete accessibility for service.

2.10.2.2 Corrosion Protection for Coastal Installations

Provide manufacturer anti-corrosion system. Corrosion system shall be a paint finish system that shall be capable of withstanding at least 3,000 hours, with no visible corrosive effects, when tested in a salt-spray and fog atmosphere in accordance with ASTM B117 test procedure.

2.10.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.10.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.11 DEHUMIDIFIERS WITH REMOTE CONDENSER UNITS

The dehumidifiers shall be industrial grade, self-contained, closed loop

heat recovery systems. Each unit shall include the following components: freon compressor, dehumidifier coil (evaporator), air reheat coil (condenser), centrifugal air moving blower, blower motor, various refrigeration components including copper piping, valves and all electrical controls and devices. The configuration of the dehumidifier shall be horizontal in design.

2.11.1 Operational Modes

1. Dehumidification and Room Air Heating.
2. Dehumidification and Room Cooling, with Remote Outdoor Condenser.

2.11.2 Cabinet Construction

The base panel shall be 11-gauge galvanized steel with 11 gauge welded supports on the bottom side for maximum rigidity. The frame panels, removable access doors and top panels shall be 16 or 20 gauge galvanized steel. Removable access doors shall provide access to all replaceable components of the unit. The electrical compartment shall be separated from the mechanical area with access with its own door from the outside of the cabinet.

2.11.3 Paint and Cabinet Finish

All metal parts shall be galvanized coated steel in its raw state. All metal cabinet parts shall be powder coated with high temperature curing.

2.11.4 Dehumidification Coil (Evaporator)

Coil tubes shall be made from 3/8-inch or 1/2-inch OD seamless drawn copper and be hydraulically extruded into the fins. All headers, manifolds and connecting copper tubing shall be made from heavy wall seamless tubing. Final testing shall consist of leak testing with 420 psig nitrogen gas and sealed after testing to avoid contamination. Coil casing shall be at least 18 gauge galvanized steel. Coil shall have corrosion protection. Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90 using scribed aluminum test coupons.

2.11.5 Air Reheat Coil (Condenser)

This coil shall be constructed with seamless drawn, copper tubing, hydraulically expanded into the fin collars. Coil fins shall be tempered aluminum with extruded collars. All headers shall be constructed from heavy wall seamless copper tubing. Coil casing shall be made from at least 18 gauge galvanized steel. Coil testing shall be leak tested with at least 420 psig nitrogen gas and then sealed to avoid contamination. Coil shall have corrosion protection. Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90 using scribed aluminum test coupons.

2.11.6 Compressor

The freon compressor shall be a hermetic scroll design with crankcase heater. The compressor shall be protected with both high and low pressure safety switches and internally protected from both overheating and over pressure situations. The compressor shall be vibration isolated externally and internally.

2.11.7 Low Ambient Control

The low ambient control shall control discharge pressure regardless of ambient temperature. A hot gas bypass valve shall prevent evaporator coil freeze ups and the need for defrost timers. This control shall also be externally adjustable.

2.11.8 Freon Receiver Vessel

This receiver shall be safety laboratory listed and meet ASME standards for 400 psig maximum working pressure. Receivers shall also be fitted with pressure safety relief valves listed by safety laboratories for such use. This receiver shall also be equipped with roto-lock refrigeration valves to provide for freon pump down for easy replacement of components.

2.11.9 Condensate Drain Pan

The drain pan shall be constructed from 20-gauge or heavier stainless steel with silver soldered seams. This pan shall be securely attached with clips, but easily removed for cleaning.

2.11.10 Electrical Control Panel

The electrical control panel with hinged door and quarter turn latch shall be readily accessible from the front of the unit. The electrical controls shall include IEC starters for compressor (three phase only) and blower motor and interlock relay. A low voltage power supply to supply 24 volt control power with integral circuit breaker or fused protection. Clearly labeled high and low voltage terminal strips, potential relay, start and run capacitors, automatic reset of low pressure cut-out and a short cycling timer to prevent against rapid cycling of compressor. The indicating lights shall be displayed outside the cabinet.

2.11.11 Refrigeration Circuitry

All refrigeration copper tubing and components shall be coated with a clear polyurethane coating to prevent early deterioration and degradation. The entire refrigeration system to be pumped down to no less than 500 microns and charged with the appropriate amount of HFC 407C.

2.11.12 Insulation

The sound and thermal insulation shall be applied to the bottom, top and all interior sides of the cabinets. It shall be fiberglass, bonded with a thermosetting resin and flame-attenuated, have a maximum flame spread index of 25 and maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.11.13 Air Blower Assembly

The blower shall be a double inlet, forward curve, centrifugal, low RPM type blower that is dynamically and statically factory balanced. Permanently lubricated ball bearings shall provide at least 200,000 hours of average life. The blower shall be vibration isolated when mounted to the cabinet floor.

2.11.14 Blower Motor

The blower motor shall be a totally enclosed fan cooled design (TEFC),

continuous duty, with overload protection. It shall have permanently lubricated ball bearings. The motor shall carry a UL and CSA Listing. Blower motor shall be base mounted and not attached to blower mechanically.

2.11.15 Blower Drive Components

The motor pulley and blower pulley shall be machined cast iron in construction. The motor pulley shall be a variable pitch type that is field adjustable to vary CFM and external static pressure. The pulleys shall be single V-belt.

2.11.16 Remote Condenser Coil

This coil shall be constructed with seamless drawn, copper tubing, hydraulically expanded into the fin collars. Coils shall be 3/8-inch or 1/2-inch OD copper arranged in a staggered design. Coil fins shall be tempered aluminum with extruded collars. All headers shall be constructed from heavy wall copper tubing. Coil casing shall be made from at least 18 gauge galvanized steel. Coil testing shall be leak tested with at least 420 psig nitrogen gas and then sealed to avoid contamination.

2.11.17 Remote Condenser Electrical Control Panel

The electrical control panel shall be readily accessible from one side of the unit. All necessary motor starters and protection devices shall be housed in this panel.

2.11.18 Remote Condenser Air Blower Assembly (CU-2A Base Bid and CU-1A)

The blower shall be a double inlet, forward curve, centrifugal, low RPM type that is dynamically and statically factory balanced. Permanently lubricated ball bearings shall provide at least 200,000 hours of average life. The blower shall be vibration isolated when mounted to the cabinet floor.

2.11.19 Remote Condenser Blower Motor

The blower motor shall be a totally enclosed fan cooled design (TEFC), continuous duty with overload protection. It shall have permanently lubricated ball bearings. It shall carry a UL or CSA listing.

2.11.20 Remote Condenser Blower Drive Components (CU-2A Base Bid and CU-1A)

The motor pulley shall be machined cast iron in construction. The motor pulley shall be a variable pitch type that is field adjustable to vary CFM and external static pressure. The pulleys shall be a single V-belt.

2.11.21 Remote Condenser Head Pressure Controls

This unit shall be equipped to operate as a full flooding system for operation down to minus 20 degrees F.

2.11.22 Remote Condenser Fan and Coil Guards

Plated or painted welded wire guards will be constructed for maximum rigidity and safety protection.

2.11.23 Option 3 Only - CU-2A Air Blower Assembly

Dynamically balanced propeller blades with painted steel hubs. Fan shall be direct drive.

2.12 SPACE THERMOSTATS

2.12.1 Electrical Control

Provide low-voltage type space thermostat with non-setback/setup temperature control for heating only (DH-3) and cooling and heating (DH-1A and DH-2A). Provide thermostat that conforms to NEMA DC 3, and is as indicated.

2.13 ROOM HUMIDISTATS

Provide room humidistats that are wall-mounted, reverse acting, proportioning type, with adjustable minimum throttling range no greater than 2-percent relative humidity. Provide humidistats that are capable of maintaining the relative humidity within the limits of the throttling range for relative humidity of 30 to 80 percent and temperatures to 110 degrees F.

2.14 SUPPLEMENTAL COMPONENTS/SERVICES

2.14.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate as indicated on Drawings.

2.14.2 Sampling Sink

20 gauge, Type 304 stainless steel hard sink with buffed satin finish. 12 inch by 9 inch bowl. Provide with wall hanger and grid strainer.

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 3 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.

3.2.2 Equipment and Installation

Provide frames and supports for dehumidifiers, fans, and other similar items requiring supports. Anchor and fasten as recommended by the manufacturer. Set floor-mounted equipment on existing concrete pads. Under Option 3, provide concrete for extension of existing foundations as specified in Section 03 31 29 MARINE CONCRETE.

3.2.3 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.

3.2.4 Ductwork

Provide ductwork that is fabricated from Type 316L, stainless steel.

3.2.5 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.

3.2.6 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.

3.2.7 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.

3.2.8 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

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. When the work area is in an occupied space such as the operating level protect all furniture and equipment from dirt and debris. 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 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.6 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.

3.7 ADJUSTING

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.

3.8 OPERATION AND MAINTENANCE

3.8.1 Operation and Maintenance Manuals

Submit six 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. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

3.8.2 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.

-- 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

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

SMACNA 1966 (2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. 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; G

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. Refer to "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS (PWD ME). 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.

1.4.4 Licensing

Provide proof of maintaining the proper license(s), if any, as required to do work in the State of Maine. Comply with all Federal, State and local rules, regulations, and licensing requirements.

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; and
- 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 to the dehumidifiers, the interior surfaces of the dehumidifiers, mixing box, coil compartment, condensate drain pans, supply air ducts, fans, fan housing, fan blades, turning vanes, filters, filter housings, reheat coils, 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 10 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 Dehumidifiers, 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 scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. Remove all visible surface contamination deposits in accordance with NADCA

Standards.

- a. Clean all dehumidifier 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 Methods of Cleaning Fibrous Glass Insulated Components

Thoroughly clean glass thermal or acoustical insulation elements present in any equipment or ductwork with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

Do not use cleaning methods which cause damage to fibrous glass components or which will render the system capable of passing Cleaning Verification Tests NADCA Standards.

3.5.3 Damaged Fibrous Glass Material

If there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, identify them for replacement.

When requested or specified, be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

3.5.4 Replacement Material

If replacement of fiber glass materials is required, conform all materials to applicable industry codes and standards, including those of UL and SMACNA 1966. Refer to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.5.5 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.

3.7 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

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division: 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 6,000 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 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent

instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 3,000 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.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 23 05 15

COMMON PIPING FOR HVAC (OPTION 1 ONLY)

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 WHB-2.9 (2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME A112.18.1/CSA B125.1 (2012) Plumbing Supply Fittings

ASME B1.20.7 (1991; R 2013) Standard for Hose Coupling Screw Threads (Inch)

ASME B16.1 (2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASME B31.3 (2012) Process Piping

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A270 (2014) Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing

ASTM A312/A312M (2014) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

ASTM A6/A6M (2013a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

ASTM D2564 (2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ASTM D2855 (1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and

Fittings

ASTM F104	(2011) Standard Classification System for Nonmetallic Gasket Materials
ASTM F1760	(2001; R 2011) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F2389	(2010) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

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-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends

NSF INTERNATIONAL (NSF)

NSF/ANSI 14	(2014) Plastics Piping System Components and Related Materials
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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)

1.2 GENERAL REQUIREMENTS

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.

Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.

Include with Listing of Product Installations for piping systems 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 in the list purchaser, address of installation, service organization, and date of installation.

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

Material, Equipment, and Fixture Lists; G

SD-02 Shop Drawings

Record Drawings; G

Connection Diagrams; G

Coordination Drawings; G

Installation Drawings; G

SD-03 Product Data

Pipe and Fittings; G

Piping Specialties; G

Valves; G

Miscellaneous Materials; G

Supporting Elements; G

SD-06 Test Reports

Hydrostatic Tests; G

Air Tests; G

Valve-Operating Tests; G

Drainage Tests; G

Pneumatic Tests; G

Non-Destructive Electric Tests; G

System Operation Tests; G

SD-07 Certificates

Listing of Product Installations; G

Records of Existing Conditions; G

Surface Resistance; G

Shear and Tensile Strengths; G

Temperature Ratings; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

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 Polypropylene Pipe

Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F2389. Pipe shall

be made in a three layer extrusion process. Piping shall contain a fiber layer (faser) to restrict thermal expansion. Pipe shall comply with the rated pressure requirements of ASTM F 2389. Layers shall be incorporated in the pipe wall to limit thermal expansion to 2 1/4-inches per 100 F per 100-ft. If the hydronic system includes ferrous components, an oxygen barrier is required in the pipe wall.

Pipe shall be certified by NSF International as complying with NSF/ANSI 14, and ASTM F2389

Where pipe is exposed to direct UV light for more than 30 days, provide a Factory applied, UV-resistant coating or alternative UV protection.

2.1.2 PVC Pipe (Condensate Drains)

PVC pipe shall contain a minimum of 25 percent recycled content in accordance with ASTM F1760. Plastic solvent cement for PVC plastic pipe shall conform to ASTM D2564 and ASTM D2855.

2.1.3 Stainless-Steel Tubing

Stainless-Steel Tube: ASTM A270, Grade TP316L, seamless, with wall thickness not less than ASTM A312/A312M, Schedule 10, unless otherwise indicated; with seamless, stainless-steel fittings matching tube thickness and grade, for welded joints.

2.1.4 Refrigerant Piping

Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

2.2 PIPING SPECIALTIES

Submit performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.2.1 Hose Faucets

Construct hose faucets with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1/CSA B125.1. Hose-coupling screw threads shall conform to ASME B1.20.7.

Provide vandal proof, atmospheric-type vacuum breaker on the discharge of all potable water lines.

2.2.2 Pressure Gages

Pressure gages shall conform to ASME B40.100 and to requirements specified herein. Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be 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. All gages shall be Grade B or better and be equipped with gage isolators.

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.

2.3.1 Stainless Steel Gate Valves (GAV)

Gate valves 2-1/2 inches and larger, shall be 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 stainless steel trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.3.2 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. Valve shall be 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 shall be 316 stainless steel. Select disks using manufacturer's 316 stainless steel. Pins, springs, and miscellaneous trim shall be manufacturer's standard 316 stainless steel. Disk and shaft seals shall be Buna-N elastomer tetrafluoroethylene.

2.3.3 PVC Ball Valves

Schedule 40, true union, PVC ball valves with EPDM or FKM seats and seals.

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 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.

2.5 SUPPORTING ELEMENTS

Submit equipment and performance data for the supporting elements consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

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. Supporting elements shall be 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.

Supporting elements shall conform to requirements of ASME B31.3 and MSS SP-58, except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be 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. Masonry anchor group-, type-, and style-combination designations shall be 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

Anchor devices shall 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 C-Clamps

Do not use C-clamps.

2.5.1.3 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 through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

2.5.3 Vertical Pipe Attachments

Vertical pipe attachments shall be 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, and Temperature Ratings.

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.

Make final connections to equipment with flanges.

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.

For polypropylene pipe, make fusion-weld joints in accordance with the pipe and fitting manufacturer's specifications and product standards. Use fusion-weld tooling, welding machines, and electrofusion devices specified by the pipe and fittings manufacturer. Prior to joining, prepare the pipe and fittings in accordance with ASTM F2389 and the manufacturer's specifications. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated.

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.

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 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 hangars 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. For concentrated loads such as valves, reduce the allowable span proportionately.

Provide vibration isolation supports where needed.

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. Risers shall 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.

3.4 DISINFECTION

Flush piping with potable water until visible grease, dirt and other contaminants are removed (visual inspection).

3.5 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.

-- 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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002; 6th ed) National Standards for
Total System Balance

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 (2004) HVAC Sound And Vibration Manual -
First Edition

1.2 DEFINITIONS

- a. AABC: Associated Air Balance Council.
- b. COTR: Contracting Officer's Technical Representative.
- c. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.
- d. NEBB: National Environmental Balancing Bureau.
- e. Out-of-tolerance data: Pertains only to field acceptance testing of Final TAB report. 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."

- f. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).
- g. TAB: Testing, adjusting, and balancing (of HVAC systems).
- h. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.
- i. TAB Agency: TAB Firm.
- j. TAB team field leader: TAB team field leader.
- k. TAB team supervisor: TAB team engineer.
- l. TAB team technicians: TAB team assistants.
- m. 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 testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air distribution systems including ducts which are located within, on, under, between, and adjacent to buildings.

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 TAB of the indicated existing systems and equipment and submit the specified TAB reports for approval. Conduct 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 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 (PWD ME).

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 25 NETWORK ANALYSIS SCHEDULES (NAS) (PWD ME).

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

TAB Agency; G

Designation of TAB team assistants; G

Designation of TAB team engineer; G

Designation of TAB team field leader; G

SD-06 Test Reports

TAB Work Execution Schedule; G

TAB Procedures Summary; G

Design review report; G

SD-07 Certificates

Independent TAB agency and personnel qualifications; G
Completed Pre-TAB Work Checklist; G
TAB Submittal and Work Schedule; G
Design review report; G
Pre-field TAB engineering report; G
Advanced notice for TAB field work; G
Prerequisite HVAC Work Check Out List; G
TAB Reports; 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.

1.6 SEQUENCING AND SCHEDULING

1.6.1 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.

1.6.1.1 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. All elements of the TAB work are addressed on this premise.

1.6.2 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-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 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; and conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work.

1.6.2.1 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.

1.6.2.2 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.

1.7 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 (PWD ME), 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.

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-TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) to develop a mutual understanding relative to the details of the 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 TAB PROCEDURES

3.3.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured air flow rates 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 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.

3.3.2 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.

3.3.3 TAB Air Distribution Systems

3.3.3.1 Units With Coils

Report heating and cooling performance capacity tests for electric 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 units with capacities of 7.5 tons (90,000 Btu) or less:

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.

3.3.3.2 Dehumidifiers

Dehumidifier systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.3.3.3 Supply and Exhaust Air Fans

Fan system including fan ducts, registers, diffusers, grilles, and louvers for supply air and exhaust air.

3.3.4 TAB Work on Performance Tests Without Seasonal Limitations

3.3.4.1 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 cooling systems.

3.3.4.2 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.

3.3.4.3 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.

3.3.4.4 Coils

Report heating and cooling performance capacity tests for electric 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 units with capacities of 7.5 tons (90,000 Btu) or less:

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.

3.3.5 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.

3.3.6 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.

3.3.7 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - TAB.

3.3.8 Quality Assurance - COTR TAB Field Acceptance Testing

3.3.8.1 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 dehumidifiers and coils.

Group 2: 25 percent of the supply diffusers, registers, grilles associated with dehumidifiers and fans.

Group 3: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 4: 100 percent of the supply fans, and exhaust fans.

Further, if any data on the TAB Report for Groups 2 through 4 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.

3.3.8.2 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.

3.3.8.3 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.

3.4 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.

3.5 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.

3.6 APPENDICES

Appendix A WORK DESCRIPTIONS OF PARTICIPANTS
Appendix B REPORTS - TAB

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 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 "TAB Schedule" are met.
- c. Pre-TAB meeting: Arrange and conduct the Pre-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 TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, 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 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 the duct systems are properly insulated and

vapor sealed upon the successful completion and acceptance of the TAB work.

2. TAB Team Supervisor

- a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical TAB procedures and TAB team field work.
- b. Schedule: Ensure the requirements specified under the paragraph "TAB Schedule" are met.
- c. Submittals: Provide the submittals specified herein.
- d. Pre-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 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 TAB Procedures Summary, the during the 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-TAB Checklists are completely and successfully conducted before TAB field work is performed.

- g. Technical Assistance: Provide technical assistance to the TAB field work.
- h. 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.
- i. 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 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 - 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. 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. TAB Procedures Summary

Submit a detailed narrative describing all aspects of the TAB field work to be performed. Include the following:

- a. A list of the intended procedural steps for the 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 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 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.
- g. 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" 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 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 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. TAB Reports: Submit TAB Reports in the following manner:

- a. Procedure Summary: Submit a copy of the approved 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:

Level 1, Level 2 and Operating Level

- (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: DH-3, DH-4 and DH-5. 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, electric resistance heating coils and heat reclaim devices 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, moisture eliminators, or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork.

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 supply, exhaust 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 fan curves for fans TAB'd on the job.

- i. 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."

-- 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; Errata 1-4 2011; INT 1-12 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI and DS 2012; Errata 5-9 2012; INT 13-16 2012; Errata 10-12 2013; INT 17-18 2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167 (1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A580/A580M (2013b) Standard Specification for Stainless Steel Wire

ASTM B209 (2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C1136 (2012) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

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 C534/C534M (2013) Standard Specification for Preformed Flexible Elastomeric Cellular

	Thermal Insulation in Sheet and Tubular Form
ASTM C612	(2014) Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C795	(2008; R 2013) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
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 D2863	(2013) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
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	(2009) 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	(2001) 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

MIL-PRF-19565 (1988; Rev C) Coating Compounds, Thermal
Insulation, Fire- and Water-Resistant,
Vapor-Barrier

UNDERWRITERS LABORATORIES (UL)

UL 723 (2008; Reprint Aug 2013) Test for Surface
Burning Characteristics of Building
Materials

UL 94 (2013) 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.

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:

Fiberglass	20-25 percent glass cullet by weight
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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 two SD types, SD-03 Product Data and SD-08 Manufacturer's Instructions at the same time for each system.

SD-03 Product Data

Pipe Insulation Systems; G
Duct Insulation Systems; 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.

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. 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 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.2 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 white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding 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.

2.2.1.3 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 Staples

Outward clinching type monel or ASTM A167, Type 316 stainless steel.

2.2.8 Jackets

2.2.8.1 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 316 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.

2.2.8.2 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.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 43 mils dry film thickness as determined according to procedure B of ASTM E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.2.9.3 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.

2.2.10 Wire

Soft annealed ASTM A580/A580M Type 316 stainless steel, 16 or 18 gauge.

2.2.11 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge, Type 316 stainless steel.

2.2.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum 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 materials shall conform to Table 1. Insulation thickness shall be 1 inch and meet or exceed the requirements of ASHRAE 90.1 - IP. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.1.1 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I for tubular materials.

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.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests 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 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.

3.2.1.2 Pipes Passing Through Hangers

Insulation 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 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation.

3.2.1.2.2 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2

inches, and seal as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.3 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.4 Pipe Insulation Material

TABLE 1					
Insulation Material for Piping					
Service					
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated:

- a. Refrigerant suction lines.

3.2.2.1 Factory or Field Applied Jacket

Insulation outside the building, to be protected with an aluminum jacket or greater than 3 ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required.

3.2.2.2 Installing Insulation for Straight Runs Cold Pipe

3.2.2.2.1 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

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 and heated conditioned air.

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 2.

Table 2 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0
Fresh Air Intake Ducts	2.0
Reactivation Air Discharge Ducts	2.0

3.3.2 Insulation and Vapor Retarder/Weatherproofing Jacket for Cold and Warm Air Duct

Insulation and vapor retarder/weatherproofing jacket shall be provided for the following cold and warm air ducts and associated equipment.

- a. Supply ducts.
- b. Fresh air intake ducts and plenums.
- c. Reactivation exhaust air ducts.

Insulation for rectangular ducts shall be rigid type, minimum density 3 pcf. Insulation for all exposed ducts shall be provided with a field applied vapor barrier/weather barrier jacket coating finish as specified. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation and vapor barrier/weather barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor barrier/weather 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 SYSTEMS.

3.3.2.1 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 stainless 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.

3.3.3 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.

-- End of Section --

SECTION 23 08 00.00 10
 COMMISSIONING OF HVAC SYSTEMS
 01/08

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.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard (2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

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

SMACNA 1429 (1994) HVAC Systems Commissioning Manual, 1st Edition

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC (2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

1.2 DEFINITIONS

In some instances, terminology differs between the Contract and the Commissioning 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 ACG, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	ACG	NEBB	TABB
Commissioning Standard	ACG Commissioning Guideline	Procedural Standards for Building Systems Commissioning	SMACNA HVAC Commissioning Guidelines

SIMILAR TERMS			
Contract Term	ACG	NEBB	TABB
Commissioning Specialist	ACG Certified Commissioning Agent	NEBB Qualified Commissioning Administrator	TABB Certified Commissioning Supervisor

1.3 SYSTEM DESCRIPTION

1.3.1 General

Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB Commissioning Standard, or SMACNA 1429 unless otherwise stated herein. Consider mandatory all recommendations and suggested practices contained in the Commissioning Standard. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Specialist and calibration of Commissioning instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the Commissioning Standard, Commissioning procedures shall be developed by the Commissioning Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.3.2 Energy

Formal LEED NC certification is not required; however, the Contractor is required to provide documentation that meets the LEED NC Energy & Atmosphere (EA) Prerequisite 1, Fundamental Commissioning.

1.3.3 Related Requirements

Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS (PWD ME) for general commissioning requirements for work specified in Division 23.

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

Commissioning Plan; G

SD-03 Product Data

Pre-Functional Performance Test Checklists; G

Functional Performance Tests; G

SD-06 Test Reports

Commissioning Report; G

SD-07 Certificates

Commissioning Firm; G

Commissioning Specialist; G

1.5 QUALITY ASSURANCE

1.5.1 Commissioning Firm

Submit certification of the proposed Commissioning Firm's qualifications to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. The firm is either a member of ACG 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. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Firm for approval. Any firm that has been the subject of disciplinary action by the ACG, 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 Commissioning. All work specified in this Section and in other related Sections to be performed by the Commissioning Firm shall be considered invalid if the Commissioning Firm loses its certification prior to Contract completion and must be performed by an approved successor. These Commissioning services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of all other subContractors. The Commissioning Firm shall report to and be paid by the prime Contractor.

1.5.2 Commissioning Specialist

1.5.2.1 General

Submit certification of the proposed Commissioning Specialist's qualifications to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. The Commissioning Specialist shall be an ACG Certified Commissioning Agent, a NEBB Qualified Commissioning Administrator, or a TABB Certified Commissioning Supervisor and shall be an employee of the approved Commissioning Firm. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Specialist shall be described in detail. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Commissioning Specialist

loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Any individual that has been the subject of disciplinary action by the ACG, 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 Commissioning. All work specified in this Section and in other related Sections performed by the Commissioning Specialist shall be considered invalid if the Commissioning Specialist loses certification prior to Contract completion and must be performed by the approved successor.

1.5.2.2 CONTRACTOR'S RESPONSIBILITIES

- a. Perform commissioning tests at the direction of the CxA.
- b. Attend construction phase controls coordination meeting.
- c. Attend testing, adjusting, and balancing review and coordination meeting.
- d. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the Commissioning Specialist.
- e. Provide information requested by the Commissioning Specialist for final commissioning documentation.
- f. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5.2.3 COMMISSIONING SPECIALIST RESPONSIBILITIES

- a. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- b. Direct commissioning testing.
- c. Verify testing, adjusting, and balancing of Work are complete.
- d. Provide test data, inspection reports, and certificates in Systems Manual.

1.5.2.4 COMMISSIONING DOCUMENTATION

- a. Provide the following information to the CxA for inclusion in the Commissioning Plan:
 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 6. Test and inspection reports and certificates.
 7. Corrective action documents.
 8. Verification of testing, adjusting, and balancing reports.
 9. POR (Program of Requirements) and BoD (Basis of Design) documents.

1.6 SEQUENCING AND SCHEDULING

Begin the work described in this Section only after all work required in related Sections has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Pre-Functional Performance Test Checklists shall be performed at appropriate times during the construction phase of the Contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 COMMISSIONING PLAN

Commissioning Plan: The Commissioning Specialist shall develop a commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. The commissioning plan shall identify how commissioning responsibilities are distributed. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction.

1. Identify who will be responsible for producing the various procedures, reports, Owner notifications and forms.
2. Include the commissioning schedule.
3. Describe the test/acceptance procedure.

3.2 COMMISSIONING TEAM AND TEST FORMS AND CHECKLISTS

Designate Contractor team members to participate in the Pre- Functional Performance Test Checklists and the Functional Performance Tests specified herein. In addition, the Government team members will include a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency's Representative. The team members shall be as follows:

Designation	Function
A	Contractor's Commissioning Specialist
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing (TAB) Specialist
C	Contractor's Controls Representative
D	Design Agency Representative
O	Contracting Officer's Representative

Designation	Function
U	Using Agency's Representative

Acceptance by each commissioning team member of each Pre- Functional Performance Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

3.3 TESTS

Perform the pre-functional performance test checklists and functional performance tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre- functional performance tests checks and functional performance tests. A functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test.

3.3.1 Pre-Functional Performance Test Checklists

Perform Pre-Functional Performance Test Checklists at least 28 days prior to the start of Pre-Functional Performance Test Checks. Correct and re-inspect deficiencies discovered during these checks in accordance with the applicable contract requirements. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

3.3.2 Functional Performance Tests

Submit test procedures at least 28 days prior to the start of Functional Performance Tests. Submit the schedule for the tests at least 14 days prior to the start of Functional Performance Tests. Begin Functional Performance Tests only after all Pre-Functional Performance Test Checklists have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Begin Tests with equipment or components and progress through subsystems to complete systems. Upon failure of any Functional Performance Test item, correct all deficiencies in accordance with the applicable contract requirements. The item shall then be retested until it has been completed with no errors.

3.4 COMMISSIONING SCOPE

HVAC system and equipment commissioning scope includes the following for equipment and systems provided under this project:

1. Dehumidifier (DH-1A) and Interconnected Condenser Unit (CU-1A).
2. Dehumidifier (DH-2A) and Interconnected Condenser Unit (CU-2A).

3. Dehumidifier (DH-3).
4. Dehumidifier (DH-4).
5. Dehumidifier (DH-5).
6. Dehumidifier (DH-3) Electric Heating Coil (EDH-3).
7. Supply Fan SF-1A.
8. Exhaust Fan EF-1A.
9. Controls.
10. Piping Systems.
11. Ductwork Systems.

3.5 COMMISSIONING REPORT

Submit the Commissioning Report, no later than 14 days after completion of Functional Performance Tests, consisting of completed Pre-Functional Performance Test Checklists and completed Functional Performance Tests organized by system and by subsystem and submitted as one package. The Commissioning Report shall also include all HVAC systems test reports, inspection reports (Preparatory, Initial and Follow-up inspections), start-up reports, TAB report, TAB verification report, Controls start-up test reports and Controls Performance Verification Test (PVT) report. The results of failed tests shall be included along with a description of the corrective action taken.

-- 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 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 02 EXISTING CONDITIONS and Division 23, HEATING, VENTILATING, AND AIR CONDITIONING. This section applies to all sections of Divisions 26, 27 and 28 ELECTRICAL, COMMUNICATIONS, and ELECTRONIC SAFETY AND SECURITY, 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

Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and

equipment operations and that refer to this section for detailed description of submittal types.

- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 60 Hz, 480 volts secondary, three phase, three wire.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless

stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription

shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

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 FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two stainless steel rivets.

-- 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)

- | | |
|------------|---|
| NEMA 250 | (2008) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| 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 | (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum) |
| NEMA MG 1 | (2011; Errata 2012) Motors and Generators |
| NEMA MG 10 | (2001; R 2007) 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
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
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2012) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011) American National Standard for Product Safety Signs and Labels

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 2014) National Electrical Code
NFPA 70E	(2012; Errata 1) Standard for Electrical Safety in the Workplace

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-569	(2012c; Addendum 1 2013; Errata 2013) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-607	(2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

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

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)
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UNDERWRITERS LABORATORIES (UL)

UL 1063	(2006; Reprint Jul 2012) Machine-Tool
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Wires and Cables

UL 198M (2003; Reprint Feb 2013) Standard for Mine-Duty Fuses

UL 20 (2010; Reprint Feb 2012) General-Use Snap Switches

UL 360 (2013; Reprint May 2013) 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 (2010) Thermoset-Insulated Wires and Cables

UL 467 (2007) Grounding and Bonding Equipment

UL 486A-486B (2013; Reprint Dec 2013) Wire Connectors

UL 486C (2013; Reprint Dec 2013) Splicing Wire Connectors

UL 489 (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 498 (2012; Reprint Aug 2013) Attachment Plugs and Receptacles

UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations

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) Conduit, Tubing and Cable Fittings

UL 514C (1996; Reprint Nov 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 651 (2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

UL 67 (2009; Reprint Jan 2013) Standard for

Panelboards

UL 83	(2008) Thermoplastic-Insulated Wires and Cables
UL 870	(2008; Reprint Feb 2013) Standard for Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2006; Reprint Jun 2012) Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, 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 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards; G

Wireways; G

Marking strips drawings; G

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Enclosed circuit breakers; G

Motor controllers; G

Include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

Ground-fault receptacle test; G

SD-07 Certificates

Fuses; G

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

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 6,000 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 Plastic Coated Rigid Steel Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2, UL 651.

2.2.3 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.4 Fittings for PVC Coated Rigid Steel Conduit

Threaded-type, PVC coated. Split couplings unacceptable.

2.2.5 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 OUTLET BOXES AND COVERS

UL 514C, nonmetallic.

- a. Provide gaskets to ensure watertight installation.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, NEMA 4X, stainless steel.

2.5 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.

2.5.1 Conductors

Provide the following:

- a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.
- b. Conductors No. 10 AWG and larger diameter: stranded.
- c. Conductors No. 12 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.

2.5.1.1 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.

2.5.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.5.2.1 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.

2.5.2.2 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 volt, three-phase
 - (1) Phase A - brown
 - (2) Phase B - orange
 - (3) Phase C - yellow

2.5.3 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 or Type XHHW or RHW conforming to UL 44, 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.

2.5.4 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.

2.6 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.

2.7 DEVICE PLATES

Provide the following:

- a. UL listed, one-piece device plates for outlets to suit the devices installed.
- b. For nonmetallic boxes and fittings, provide gasketed, nonmetallic plates.

- c. Screws: stainless steel machine-type with countersunk heads.
- d. Sectional type device plates are not be permitted.
- e. Plates installed in wet locations: gasketed and UL listed for "wet locations." Provide as wet location-in-use type for receptacles.

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

- a. Handles: brown thermoplastic.
- b. Wiring terminals: screw-type, side-wired.
- c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.
- d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 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 4X, non-metallic enclosure per NEMA ICS 6.

2.9 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. 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.

2.9.1 Fuseholders

Provide in accordance with UL 4248-1.

2.9.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-5 time-delay type. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.10 RECEPTACLES

Provide the following:

- a. UL 498, hard use (also designated heavy-duty), grounding-type.
- b. Ratings and configurations: as indicated.
- c. Bodies: brown as per NEMA WD 1.
- d. Face and body: thermoplastic supported on a metal mounting strap.

- e. Dimensional requirements: per NEMA WD 6.
- f. Screw-type, side-wired wiring terminals.
- g. Grounding pole connected to mounting strap.
- h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.10.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations". Include nonmetallic box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized cover plate.

2.10.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.11 PANELBOARDS

Provide panelboards in accordance with the following:

- a. UL 67 and UL 50 having a short-circuit current rating as indicated.
- b. Panelboards: circuit breaker-equipped.
- c. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.
- d. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.
- e. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise.
- f. Main breaker: "separately" mounted "above" or "below" branch breakers.
- g. Where "space only" is indicated, make provisions for future installation of breakers.
- h. Directories: indicate load served by each circuit in panelboard.
- i. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).
- j. Provide new directories for existing panels modified by this project as indicated.
- k. Type directories and mount in holder behind transparent protective covering.

- l. Panelboards: listed and labeled for their intended use.
- m. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.11.1 Enclosure

Provide panelboard enclosure in accordance with the following:

- a. UL 50.
- b. Cabinets: stainless steel, NEMA 4X rated.
- c. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.
- d. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch.
- e. Each door: fitted with a combined catch and lock, except that doors over 24 inches long provided with a three-point latch having a knob with a T-handle, and a cylinder lock.
- f. Keys: two provided with each lock, with all locks keyed alike.
- g. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.11.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. Buses shall be copper.

2.11.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for

Class A ground-fault circuit interrupter.

2.11.3.3 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.12 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. NEMA 4X stainless steel enclosures. Provide solid neutral. Provide copper ground bus.

Provide with key interlock system as indicated.

2.13 MOTORS

Provide motors in accordance with the following:

- a. NEMA MG 1.
- b. Hermetic-type sealed motor compressors: Also comply with UL 984.
- c. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.
- d. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.
- e. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.
- f. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.
- g. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.
- h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.13.1 High-Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.13.2 Premium Efficiency Polyphase Motors

Select polyphase motors based on high-efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction

motors must meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.13.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.13.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.14 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.
- n. Minimum short circuit withstand rating of combination motor controller: 10,000 rms symmetrical amperes.

2.14.1 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.

2.14.2 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.

2.14.2.1 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.

2.14.3 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 fuses in each ungrounded primary feeder. Provide one fused secondary lead with the other lead grounded. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.14.4 Enclosures for Motor Controllers

NEMA ICS 6. NEMA 4X, nonmetallic.

2.14.5 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. Enclosures: NEMA 4X stainless steel.

2.14.6 Pilot and Indicating Lights

Provide LED cluster lamps. Provide "Power" and "Run" lights.

2.15 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 "Heating, Ventilating, and Air Conditioning" for mechanical isolation of machines and other equipment.

2.16 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires, wireways, and other accessories for telecommunications outlets and pathway in accordance with TIA-569 and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.17 GROUNDING AND BONDING EQUIPMENT

UL 467.

2.17.1 Ground Bus

Copper ground bus: provide as indicated.

2.18 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.

2.19 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.

- h. Fasten with minimum of two stainless steel screws. Do not alter NEMA rating of enclosures.

2.20 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for enclosed circuit breakers, panelboards, and motor controllers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.21 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00 FIRESTOPPING.

2.22 WIREWAYS

UL 870. Material: stainless steel, NEMA 4X, 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in size and length required for the application with hinged-cover NEMA 4X enclosure per NEMA ICS 6.

2.23 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

- a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.
- b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.
- c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.
- d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.
- e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.
- f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Light Gray.
- g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof, wet, corrosive, 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 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.1.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, all new, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.1.2 Wiring Methods

Provide insulated conductors installed in PVC coated rigid steel conduit, or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 3/4 inch in diameter for low voltage lighting and power circuits. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00 FIRESTOPPING.

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.

3.1.3 Conduit Installation

Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where conduit will be visible after completion of project. Run conduits as if exposed.

3.1.3.1 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.
- (2) Do not use outside above grade, except where indicated otherwise.

3.1.3.2 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).

3.1.3.3 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod, conduit hangers, or ceiling trapeze by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Supports and hardware shall be NEMA 4X stainless steel. 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. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with mechanical systems to assure maximum accessibility to all systems. Where conduit crosses expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.3.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.3.5 Threaded Hubs

Provide threaded hubs for conduit entry to stainless steel panel enclosures, device boxes, pull boxes, and junction boxes. Maintain NEMA 4X enclosure ratings.

3.1.3.6 Flexible Connections

Provide liquidtight flexible non-metallic conduit between 3 and 6 feet in length for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible conduit size: 1-inch diameter. Provide separate ground conductor across flexible connections.

3.1.3.7 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA-569.

- a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications equipment area: installed and cabling length requirements in accordance with TIA-568-C.1. Size conduits, wireways

in accordance with TIA-569 and as indicated.

- b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with TIA-569. Size conduits, wireways for telecommunications risers in accordance with TIA-569 and as indicated.

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, and when specifically indicated. Nonmetallic boxes shall be used with nonmetallic conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Provide gaskets for boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Fasten boxes and supports 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. Support stainless steel boxes directly from building structure. When penetrating reinforced concrete members, avoid cutting reinforcing steel. Fasteners, supports and hardware shall be stainless steel.

3.1.4.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep. Boxes for other than lighting fixture outlets: minimum 4 inches square. Telecommunications outlets: a minimum of 4 inches square by 2 1/8 inches deep.

3.1.4.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 and compatible with nonmetallic raceway systems. Provide boxes with gasketed, 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 panelboards, enclosed circuit breakers, motor controllers and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet. Measure mounting heights of receptacle outlet boxes in the to the bottom of the outlet box.

3.1.6 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 10 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. Identify control circuit

terminations in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS and manufacturer's recommendations. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

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. Splices and connections shall be rated for wet 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

Provide wet location gasketed plates installed in wet locations.

3.1.9 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.10 Grounding and Bonding

Provide in accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways,

telecommunications system grounds, and neutral conductor of wiring systems.

Make ground connection at main service equipment, and extend grounding conductor to existing grounding electrode system. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes electrical service, telecommunications system grounds, as well as underground metallic piping systems. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607.

3.1.10.1 Grounding Connections

Make grounding connections which are otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or non-reversible compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make non-reversible compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.10.2 Ground Bus

Provide a copper ground bus in the electrical equipment area as indicated. Noncurrent-carrying metal parts of electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to the entrance ground. Make connections and splices of the brazed, welded, bolted, or non-reversible pressure-connector type, except use bolted connections for connections to removable equipment.

3.1.10.3 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.10.4 Telecommunications System

Provide telecommunications grounding in accordance with the following:

- a. Telecommunications Bonding Conductors: Provide main telecommunications service equipment ground consisting of separate bonding conductor for telecommunications, between the TMGB and readily accessible grounding connection of the electrical service. Grounding and bonding conductors should not be placed in ferrous metallic conduit.
- b. Telecommunications Grounding Connections: Telecommunications grounding connections to the TMGB: utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections.

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.

3.1.12.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.12.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original functionality using materials and methods as if new work.

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 stainless steel sheet-metal screws or two stainless steel rivets. Maintain NEMA 4X enclosure ratings.

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.

Painting: as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 14 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. Provide report and submit for review.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Submit written results of test.

-- 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.

GREEN SEAL (GS)

GS-12 (1997) Occupancy Sensors

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)

ANSI C78.377 (2011) Specifications for the Chromaticity of Solid State Lighting Products

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2012; Amendment 1 2012) Life Safety Code

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

UNDERWRITERS LABORATORIES (UL)

UL 1310 (2011; Reprint Oct 2013) UL Standard for Safety Class 2 Power Units

UL 1598 (2008; Reprint Oct 2012) Luminaires

UL 924 (2006; Reprint Feb 2011) Standard for Emergency Lighting and Power Equipment

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

1.4.1 Lighting Control System

Provide lighting control system as indicated. Lighting control equipment shall include, if indicated: control modules, power packs, step-dimming ballasts, and occupancy sensors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following 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 Luminaires; G

LED Drivers; G

LED Emergency Driver; G

Exit signs; G

Occupancy sensors; G

Energy Efficiency

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, occupancy sensors, schematic diagrams and all interconnecting control wire, conduit, and associated hardware. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMS) for additional requirements.

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.6 QUALITY ASSURANCE

1.6.1 LED Drivers

Submit driver catalog data as required in the paragraph entitled "LED Drivers" contained herein. As an option, submit the fixture manufacturer's driver specification information in lieu of the actual driver manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "LED Drivers" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

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

6,000 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.

1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act. Submit data indicating lumens per watt efficiency and color rendition index of light source.

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 Driver Warranty

Furnish the manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the LED Driver. Driver assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the driver 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning driver shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement driver shall be identical to, or an improvement upon, the original design of the malfunctioning driver.

1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 LED LUMINAIRES

UL 1598 and 2108. Wet location, emergency-equipped complying with UL 924. Provide luminaires as indicated. Provide luminaires complete with LED light source and power supply unit. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable.

2.1.1 General Requirements

- a. Luminaire shall be fully assembled and electrically tested prior to shipment from factory.

- b. Incorporate modular electrical connections and construct luminaire to allow replacement of all or any part of the optics, heat sinks, power supply units, and electrical components using only a simple tool, such as a screwdriver.
- c. Luminaire shall have a nameplate bearing the manufacturer's name, address, model number, date of manufacture, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.1.2 Wiring

- a. All factory electrical connections shall be made using crimp, locking, or latching style connectors. Twist style wire nuts are not acceptable.

2.1.3 Power Supply Units

UL 1310. Power Supply Unit (PSU) including drivers shall meet the following requirements:

- a. Minimum efficiency of 93 lumens per watt.
- b. Rated to operate between ambient temperatures of -35°C and +50°C.
- c. Designed to operate on voltage system to which they are connected.
- d. Operating frequency: 50/60 Hz.
- e. Luminaires under a covered structure such as canopies shall be UL listed with a sound rating of "A."

2.1.4 LED Light Source

- a. Correlated Color Temperature (CCT) shall be in accordance with ANSI C78.377.
Nominal CCT: 4,000 K: 3,985 ± 275 K
- b. Minimum Color Rendering Index (CRI) shall be: 80

2.2 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Hangers shall be stainless steel threaded rod. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fixtures shall have twin-rod hangers. Threaded rods shall be a minimum 3/8-inch diameter.

2.3 SWITCHES

2.3.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.4 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type. Exit signs shall use no more than 5 watts.

2.4.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, and

fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

2.5 EMERGENCY LIGHTING EQUIPMENT

2.5.1 LED Emergency Driver

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. Provide self-testing module integral to the fixture. 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 fixture shown for each system for 90 minutes at a minimum of 20 watts. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency drivers provided with fixtures containing solid-state ballasts shall be fully compatible with the solid-state ballasts.

2.6 OCCUPANCY SENSORS

UL listed. Comply with GS-12. Occupancy sensors and power packs shall be designed to operate on the voltage indicated. Sensors and power packs shall have circuitry that only allows load switching at or near zero current crossing of supply voltage. Occupancy sensor mounting as indicated. Sensor shall have an LED occupant detection indicator. Sensor shall have adjustable sensitivity and adjustable delayed-off time range of 5 minutes to 15 minutes. Ceiling mounted sensors shall be white. Ceiling mounted sensors shall have 360 degree coverage unless otherwise indicated.

- a. Ultrasonic sensor shall be crystal controlled and shall not cause detection interference between adjacent sensors.
- b. Infrared sensors shall have a daylight filter. Sensor shall have a fresnel lens that is applicable to space to be controlled.
- c. Ultrasonic/Infrared Combination Sensor

Occupancy detection to turn lights on requires both ultrasonic and infrared sensor detection. Lights shall remain on if either the ultrasonic or infrared sensor detects movement. Infrared sensor shall have lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Ultrasonic sensor frequency shall be crystal controlled.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 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.

2.7.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

- a. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

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.

2.8 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 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with specifications, drawings, and manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation.

3.1.2 Suspended Fixtures

Threaded rods 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degree separation. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling.

3.1.3 Exit Signs and Emergency Ballasts

Wire exit signs and emergency ballasts ahead of the switch to the normal lighting circuit located in the same room or area.

3.1.4 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for equipment areas and walking motion for storage rooms, stairways, and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's

recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 10 minutes.

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. Prepare report. Submit report for review.

3.2.1 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered. Prepare report. Submit report for review.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

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 D709 (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596 (2011) Indoor Optical Fiber Cables

ICEA S-90-661 (2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568 (2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2013) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

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 2014) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-1152 (2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

TIA-455-21 (1988a; R 2012) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices

TIA-526-14 (2010b) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-526-7 (2002; R 2008) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-568-C.0 (2009; Add 1 2010; Add 2 2012) Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard

TIA-568-C.2 (2009; Errata 2010) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

TIA-568-C.3 (2008; Add 1 2011) Optical Fiber Cabling Components Standard

TIA-569 (2012c; Addendum 1 2013; Errata 2013) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-570 (2012c) Residential Telecommunications Infrastructure Standard

TIA-606 (2012b) Administration Standard for the Telecommunications Infrastructure

TIA-607 (2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

TIA/EIA-598 (2005c) Optical Fiber Cable Color Coding

TIA/EIA-604-3 (2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68 Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 1666 (2007; Reprint Jun 2012) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

UL 1863 (2004; Reprint Nov 2012) Communication Circuit Accessories

UL 444	(2008; Reprint Apr 2010) Communications Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 514C	(1996; Reprint Nov 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	(1995; Reprint Nov 2008) Standard for Marking and Labeling Systems

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, applies to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The telecommunications contractor must coordinate with the NMCI/COSC/NGEN contractor concerning access to and configuration of telecommunications spaces. The telecommunications contractor shall coordinate work effort within the telecommunications spaces with the NMCI/COSC/NGEN contractor.

1.5 SUBMITTALS

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

SD-02 Shop Drawings

Telecommunications drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Telecommunications outlet/connector assemblies; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. 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. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF

telecommunications and ER telecommunications, CD's, BD's, and FD's to the telecommunications work area outlets. The following drawings shall be provided as a minimum:

- a. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications equipment area, access points and detail call outs for common equipment rooms and other congested areas.
- b. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the application, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit

documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 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.

1.10 MAINTENANCE

1.10.1 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of existing cable shall be provided in accordance

with TIA-606. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.

- b. Termination Hardware - A record of existing patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, 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. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Copper

Copper backbone cable shall be solid conductor, 24 AWG, 100 ohm, 25-pair, Category 3, UTP, in accordance with ICEA S-90-661, TIA-568-C.1, TIA-568-C.2 and UL 444, formed into 25 pair binder groups covered with a gray thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission

performance rating (category designation) at regular length marking intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70.

2.3.1.2 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568-C.3, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS1), tight buffered fiber optic cable.

Provide plenum (OFNP) riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. The cable cordage jacket, fiber, unit, and group color shall be in accordance with TIA/EIA-598.

2.3.2 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

2.3.2.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568-C.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661. Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

2.3.2.2 Horizontal Optical Fiber

Provide optical fiber horizontal cable in accordance with ICEA S-83-596 and TIA-568-C.3. Cable shall be tight buffered, multimode, 50/125-um diameter laser optimized, OM3 or multimode, 62.5.125-um diameter, OM1. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 40 inches.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs be UL listed and labeled for wet locations in accordance with NFPA 70. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with TIA/EIA-598.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.4.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568-C.1, and TIA-568-C.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568-C.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A. UTP outlet/connectors shall comply with TIA-568-C.2 for 200 mating cycles.

UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.

2.4.2 Optical Fiber Adapters (Couplers)

Provide optical fiber adapters suitable for duplex SC in Accordance with TIA/EIA-604-3 with zirconia ceramic alignment sleeves, as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with TIA-455-21 for 500 mating cycles.

2.4.3 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Optical fiber connectors shall be duplex SC in accordance with TIA/EIA-604-3 with zirconia ceramic compatible with 62.5/125 or 50/125 multimode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 850 nm with less than a 0.2 dB change after 500 mating cycles.

2.4.4 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, TIA-568-C.2, or TIA-568-C.3; design constructed of high impact thermoplastic material to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide labeling in accordance with the paragraph LABELING in this section.

2.5 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide bonding conductors as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.7 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.

2.8 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches 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 inches high normal block style.

2.9 TESTS, INSPECTIONS, AND VERIFICATIONS

2.9.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-526-7 for single mode optical fiber, and TIA-526-14 for multimode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install UTP, and optical fiber telecommunications cabling system as detailed in TIA-568-C.1, TIA-568-C.2, and TIA-568-C.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Backbone Cable

- a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the

telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

- b. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings. Do not untwist Category 6 UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 10 feet in the telecommunications equipment area, and 12 inches in the work area outlet.

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and NFPA 70. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Work Area Outlets

3.1.3.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA-568-C.2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568-C.3.

3.1.3.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.3.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Comply with the minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.3.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.4 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.5 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process or laser printer.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 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.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3. Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, and TIA-570 for residential cabling. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Performance Tests

Perform testing for each outlet and MUTOA as follows:

- a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.
- b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

3.5.1.3 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

- a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.
- b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --

SECTION 28 31 63.00 20

ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM
10/07

PART 1 GENERAL

1.1 REFERENCES

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

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2012; Amendment 1 2012) Life Safety Code

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
2014) National Electrical Code

NFPA 72 (2013) National Fire Alarm and Signaling
Code

NFPA 90A (2012) Standard for the Installation of
Air Conditioning and Ventilating Systems

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

47 CFR 90 Private Land Mobile Radio Services

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2013) Fire Protection Engineering for
Facilities

UFC 3-600-10N (2007) Fire Protection Engineering

UFC 3-601-02 (2010) Operations and Maintenance:
Inspection, Testing, and Maintenance of
Fire Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 1971 (2002; Reprint Oct 2008) Signaling Devices
for the Hearing Impaired

UL 228 (2006; Reprint Nov 2008) Door
Closers-Holders, With or Without Integral

Smoke Detectors

UL 268	(2009) Smoke Detectors for Fire Alarm Systems
UL 464	(2009; Reprint Apr 2012) Standard for Audible Signal Appliances
UL Electrical Constructn	(2012) Electrical Construction Equipment Directory
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESCRIPTION OF WORK

1.3.1 Scope

This work includes designing and providing a new, complete, analog/addressable fire alarm system and removing the existing fire alarm system as described herein and on the contract drawings. The system shall include wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide system complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of UFC 3-600-01, UFC 3-600-10N, UFC 3-601-02, NFPA 70, NFPA 72, and NFPA 90A except as modified herein. The system layout on the drawings show the intent of coverage and are shown in suggested locations. Final quantity, layout, and coordination is the responsibility of the Contractor.

1.4 IMPAIRMENT OF FIRE ALARM SERVICE

Do not interrupt fire alarm service to the building unless permitted under the following conditions:

- a. Notify the Contracting Officer no fewer than fourteen days in advance of proposed interruption of service.
- b. Do not proceed with interruption of service without Contracting Officer's written permission.
- c. The impairment shall comply with UFC 3-601-02, NFPA 241, and base procedures.

1.5 SUBMITTALS

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

Provide six complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. The Mid-Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve submittals.

SD-02 Shop Drawings

Provide point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems which are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACP, initiating circuits, switches, relays and terminals.

Provide plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for each floor.

Provide a complete description of the system operation in matrix format on the drawings.

Provide a complete list of device addresses and corresponding messages.

Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for equipment and components.

Provide complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

Shop drawings shall be signed by the subcontractor's system designer.

Battery power calculations

Submit shop drawings not smaller than 24 by 36 inches. As a minimum, the shop drawing submittal shall include the items listed above.

Voltage drop calculations

SD-03 Product Data

Fire alarm control panel (FACP); G

Terminal cabinets/assemblies; G

Manual stations; G

Batteries; G

Battery chargers; G

Smoke sensors; G

Wiring and cable; G

Notification appliances; G

Addressable interface devices; G

Annunciator; G

Electromagnetic door holders; G

Smoke sensor testing procedures; G

Radio transmitter, antenna, and interface panels; G

Submit data on proposed equipment, including, but not limited to the items listed above. Include UL or FM listing cards for equipment provided.

SD-06 Test Reports

Furnish preliminary test results to the Contracting Officer. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer.

SD-07 Certificates

Qualifications of installer

SD-10 Operation and Maintenance Data

INTERIOR FIRE ALARM SYSTEM, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Refer to Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI) for additional requirements.

SD-11 Closeout Submittals

Prepare and submit to the Contracting Officer six sets of detailed as-built drawings. The drawings shall include complete wiring diagrams showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of devices and equipment. The drawings shall show the system as installed, including deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized mylar sheets not less than 30 by 42 inches with 8 by 4 inch title block similar to contract drawings. These drawings shall be submitted within 2 weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings shall be provided at the time of, or prior to the final acceptance test.

Submit the installer's training history for the employees involved with this contract.

1.6 ADDITIONAL SUBMITTAL REQUIREMENTS

1.6.1 Battery Power Calculations

Verify that battery capacity exceeds supervisory and alarm power requirements.

- a. Provide complete battery calculations for both the alarm and supervisory power requirements outlined in the "Emergency Power Supply" paragraph. Ampere hour requirements for each system component shall be submitted with the calculations.
- b. Provide data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, and 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.
- c. Provide voltage drop calculations to indicate that sufficient voltage is available for proper operation of the system and components, at the minimum rated voltage of the system operating on batteries.
- d. Provide a detailed description of the final acceptance testing procedures (including equipment necessary for testing smoke detectors using real smoke).

1.6.2 Qualifications of Installer

Design shall be by a National Institute for Certification in Engineering Technologies (NICET) Level III or Level IV Technician or by a registered fire protection engineer. Installer shall have an office which has been in existence for at least 3 years. Installation shall be accomplished by an electrical contractor with a minimum of 5 years' experience in the installation of fire alarm systems. The Contracting Officer may reject any proposed installer who cannot show evidence of such qualifications. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system. The Contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization which carries a stock of repair parts for the system to be furnished. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Contracting Officer and the receipt of as-built drawings and schematics of equipment provided. Prior to installation, submit data for approval by the Mid-Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer, showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least three installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

1.7 QUALITY ASSURANCE

Equipment and devices shall be compatible and operable with existing

supervisory station fire alarm system and shall not impair reliability or operational functions of existing supervising station fire alarm system.

1.7.1 Regulatory Requirements

Devices and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM and listed in FM APP GUIDE.

1.7.1.1 Requirements for Fire Protection Service

Equipment and material shall have been tested by UL and listed in UL Fire Prot Dir or approved by FM and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

1.7.1.2 Testing Services or Laboratories

Fire alarm and fire detection equipment shall be constructed in accordance with UL Fire Prot Dir, UL Electrical Constructn, or FM APP GUIDE.

1.7.2 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM, and listed or approved for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials.

1.7.3 Modification of References

- a. In NFPA publications referred to herein, consider advisory provision to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the Mid-Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer.
- b. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.9 SPARE PARTS AND TOOLS

1.9.1 Interchangeable Parts

Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts, keys, and tools shall be delivered to the Contracting Officer at the time of the final acceptance testing.

1.9.2 Spare Parts

Furnish the following spare parts and accessories:

- a. 4 audiovisual devices of each type installed
- b. 4 fuses for each fused circuit
- c. 1 electromagnetic door holder
- d. 1 manual station
- e. 2 smoke sensors and base of each type installed
- f. 3 test magnets/devices for each type of sensor installed

1.9.3 Parts List

Furnish a list, in duplicate, of all other parts and accessories which the manufacturer of the system recommends to be stocked for maintenance.

1.10 KEYS

Keys and locks for equipment shall be identical. Provide not less than six keys of each type required. Keys shall be CAT 60.

PART 2 PRODUCTS

2.1 EXISTING FIRE ALARM EQUIPMENT

Existing fire alarm equipment shall be maintained fully operational until the new equipment has been tested and accepted by the Contracting Officer. As new equipment is installed, it shall be labeled "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the Government, it shall be placed in service and connected to the station fire alarm system. New equipment shall have tags removed and the existing equipment shall be tagged "NOT IN SERVICE" until removed from the building.

2.1.1 Equipment Removal

After acceptance of the new system by the Contracting Officer, existing equipment not connected to the new system shall be removed, unused exposed conduit shall be removed, and damaged surfaces shall be restored. The material shall be removed from the site and disposed of by the Contractor.

2.1.2 Other Divisions To Be Coordinated With

Refer to the following sections for related work and coordination:

Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

Section 08 71 00 DOOR HARDWARE for door release and additional work related to finish hardware.

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

2.1.3 Manufacturer Qualifications

Components shall be of current design and shall be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

2.2 INTERIOR FIRE ALARM SYSTEM DESIGN

2.2.1 Definitions

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

- a. Analog/Addressable System: A system in which multiple signals are transmitted via the same conduction path to a remote fire alarm control unit and fire alarm control panel, decoded and separated so that each signal will initiate the specified response.
- b. Hard Wired System: A system in which alarm and supervisory initiating devices are directly connected, through individual dedicated conductors, to a central control panel without the use of analog/addressable circuits or devices.
- c. Interface Device: An addressable device which interconnects hard wired systems or devices to an analog/addressable system.
- d. Fire Alarm Control Unit: A control panel, remote from the fire alarm control panel, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm control panel.
- e. Fire Alarm Control Panel (FACP): A master control panel having the features of a fire alarm control unit and to which fire alarm control units are interconnected. The panel has central processing, memory, and input and output terminals.
- f. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door in which terminal strips are securely mounted.

2.2.2 System Operation

The system shall be a complete, supervised, noncoded, analog/addressable fire alarm system conforming to NFPA 72, UFC 3-600-01, and UFC 3-600-10N. The return portion of the loop shall be remote from the supply portion of the loop. Any single impairment of the system shall not affect the system on more than one floor/level. The system shall operate in the alarm mode upon actuation of an alarm initiating device. The system shall remain in the alarm mode until initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The system shall provide the following functions and operating features:

- a. The FACP shall provide power, annunciation, supervision, and control for the system.

- b. Provide Style Class B signaling line circuits for each floor/level.
- c. Provide Class B notification appliance circuits. The visual alarm notification appliances shall have the flash rates synchronized.
- d. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
- e. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.
- f. Provide a notification appliance silencing switch which, when activated, will silence the audible signal appliance, but will not affect the visual alarm indicator, the liquid crystal display, or the automatic notification of the fire department. This switch shall be overridden upon activation of a subsequent alarm.
- g. Provide alarm verification capability for smoke sensors. Alarm verification shall initially be set for 30 seconds.
- h. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, air handler shutdown and door release features. Operation of this programming shall indicate this action on the FACP display.
- i. Alarm, supervisory, and/or trouble signals shall be automatically transmitted to the fire department.
- j. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- k. The system shall be capable of being programmed from the panel's keypad. Programmed information shall be stored in non-volatile memory.
- l. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.
- m. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.
- n. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as an HVAC system, the addressable fire alarm relay shall be within 3 feet of the emergency control device.
- o. An alarm signal shall automatically initiate the following functions:
 - (1) Transmission of an alarm signal to the fire department.

- (2) Audible alarm and visual indication of the device operated on the fire alarm control panel (FACP) and on the annunciator.
 - (3) Continuous actuation of alarm notification appliances.
 - (4) Release of doors held open by electromagnetic devices.
 - (5) Operation of a duct smoke sensor shall shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph and the indicated Input/Output matrix.
- s. A trouble condition shall automatically initiate the following functions:
- (1) Audible alarm and visual indication of the system trouble on the FACP and on the annunciator.
 - (2) Transmission of a trouble signal to the fire department.
- t. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACP shall be 15 seconds.
- u. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP shall not exceed 200 seconds.

2.2.3 Overvoltage and Surge Protection

- a. Sensor Wiring Surge Protection: Digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The overvoltage and surge protection inputs and outputs shall be tested with the following waveforms of:
- (1) A 10 by 1,000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - (2) An 8 by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

2.2.4 Addressable Interface Devices

The addressable interface (AI) device shall provide an addressable input interface to the FACP for monitoring normally open or normally closed contact devices such as relays for output function actuation, etc.

2.2.5 Smoke Sensors

2.2.5.1 Photoelectric Smoke Sensors

Provide addressable photoelectric smoke sensors as follows:

- a. Provide analog/addressable photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke sensors shall be listed for use with the fire alarm control panel.
- b. Provide self-restoring type sensors which do not require any readjustment after actuation at the FACP to restore them to normal

operation. Sensors shall be UL listed as smoke-automatic fire sensors.

- c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
- d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.
- e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.
- f. Where indicated, the sensor shall be listed for an air velocity range from 0 ft/min to a minimum of 2,000 ft/min.
- g. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.
 - (1) Primary status
 - (2) Device type
 - (3) Present average value
 - (4) Present sensitivity selected
 - (5) Sensor range (normal, dirty, etc.)

2.2.5.2 Duct Smoke Sensors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Sensors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. (It is not permitted to cut the duct insulation to install the duct detector directly on the duct). Detectors shall have a manual reset. Detectors shall be rated for the appropriate air velocities with a minimum rating for air flows between 500 and 4,000 fpm. Detectors shall be powered from the fire alarm panel.

- a. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268 A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel.
- b. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Remote indicators shall be provided where required by NFPA 72 and where indicated on the Contract Drawings and these shall be provided with test and reset switches.
- c. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall provide for control of auxiliary contacts that provide control,

interlock, and shutdown functions specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS. Auxiliary contacts provide for this function shall be located within 3 feet of the controlled circuit or appliance. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.2.5.3 Smoke Sensor Testing

Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Submit smoke sensor testing procedures for approval.

2.2.6 Electric Power

2.2.6.1 Primary Power

Provide primary power for the FACP from the normal AC service to the Pump Well. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of circuits and devices. Make the service connection for the FACP at the a main distribution panel where shown. Provide appropriate equipment to protect against power surges. Provide a separate NEMA 4x "general purpose enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked "FIRE ALARM SYSTEM," provided with a red and white engraved plastic sign permanently affixed to the face of the switch, and provided with a lockable handle or cover.

2.2.7 Emergency Power Supply

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

2.2.7.1 Batteries

Provide sealed, maintenance-free, sealed lead acid batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.2.7.2 Capacity

Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and audible and visual signal devices under alarm conditions for an additional 10 minutes.

2.2.7.3 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged, the charger shall recharge the batteries back to 95 percent of full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate

of charge as part of the unit assembly if a high rate switch is provided.

2.2.8 System Field Wiring

2.2.8.1 Wiring Within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices shall be prohibited.

2.2.8.2 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor or level, NEMA 4x at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches high by 8 inches.

2.2.8.3 Alarm Wiring

Signaling line circuits and initiating device circuit field wiring shall be copper, No. 16 AWG size conductors at a minimum. Notification appliance circuit conductors, that contain audible alarm devices, shall be solid copper No. 14 AWG size conductors at a minimum. Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG solid copper having similar insulation. Provide wiring in minimum 3/4-inch PVC coated rigid galvanized steel conduit with water tight fittings and PVC coated rigid galvanized steel water tight back boxes. Shielded wiring shall be utilized where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP. T-taps are not permitted. Color coding is required for circuits and shall be maintained throughout the circuit.

2.2.8.4 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets or the FACP shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet and FACP shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

2.2.9 Fire Alarm Control Panel (FACP)

Provide a complete control panel fully enclosed in a lockable steel

enclosure as specified herein. Operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. The control unit shall provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. The control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation. Visual indication of alarm, supervisory, or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means.

2.2.9.1 Cabinet

Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of panels as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm Control Panel" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.2.9.2 Control Modules

Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory, or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage.

2.2.9.3 Silencing Switches

- a. Alarm Silencing Switch: Provide an alarm silencing switch at the FACP which shall silence the audible signal but not affect the visual alarm indicator. This switch shall be overridden upon activation of a subsequent alarm.
- b. Supervisory/Trouble Silencing Switch: Provide supervisory and trouble silencing switch which shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm, supervision, or trouble condition.

2.2.9.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the FACP after the initiating device or devices have been restored to normal.

2.2.9.5 Fire Alarm Signal

A fire alarm shall activate notification appliances throughout the

building. Audible devices shall be fire alarm horns which produce a three-pulse temporal pattern. Visual devices shall be strobes operating in accordance with NFPA 72.

2.2.9.6 Memory

Provide each control unit with non-volatile memory and logic for required functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.2.9.7 Field Programmability

Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer based equipment.

2.2.9.8 Input/Output Modifications

The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad. Any bypass or modification to the system shall indicate a trouble condition on the FACP.

2.2.9.9 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.2.9.10 Instructions

Provide a typewritten instruction card. Install the instructions on the interior of the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under normal, alarm, and trouble conditions. The instructions shall be approved by the Contracting Officer before being posted.

2.2.9.11 Walk Test

The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system history, but no other outputs occur.

2.2.9.12 History Logging

The control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.2.10 Annunciator

2.2.10.1 Annunciator Panel

Provide an annunciator that includes an LCD display. The display shall

indicate the device in trouble and/or alarm. Display the device name, address and actual building location.

2.2.10.2 Material

Provide the annunciator in surface mounted, weatherproof enclosure with internal heater.

2.2.10.3 Programming

Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the FACP, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

2.2.11 Manual Stations

Provide metal or plastic, surface mounted, double action, weatherproof, addressable manual stations, which are not subject to operation by jarring or vibration. Stations shall be equipped with screw terminals for each conductor. Stations which require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire-engine red with molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station.

2.2.12 Notification Appliances

2.2.12.1 Visual Alarm Signals

Provide strobe light visual alarm signals which operate on a supervised 24 volt DC circuit. The strobe lens shall comply with UL 1971 and conform to the Americans With Disabilities Act. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. The strobe flash output shall be field selectable with a 15/30/75/110 candela rated light output based on the UL 1971 test. The strobe shall have a xenon flash tube. Visible appliances may be part of an audio-visual assembly. Where more than two appliances are located in the same room or corridor, provide synchronized operation. Appliances shall be water tight.

2.2.12.2 Fire Alarm Horns

Provide surface mounted electronic multi-tone horns that produce a minimum of four distinct sounds, suitable for use in an electrically supervised circuit. Horns shall have a rating of 90 dBA at 10 feet when tested in accordance with UL 464 while emitting a slow whoop tone. Output from the horn shall be three-pulse temporal pattern. Appliances shall be water tight. Where horns and strobes are provided in the same location, they may be combined into a single unit.

2.2.12.3 Connections

Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.

2.2.13 Electromagnetic Door Holders

Where indicated on the drawings, provide magnetic fire door hold open devices. The electromagnetic holding devices shall be designed to operate on 120 VAC, and require not more than 3 watts of power to develop 25 psi of holding force. The initiation of any fire alarm shall cause the release of the electromagnetic door holding device permitting the door to be closed by the door closer. The device shall be UL listed based on UL 228 tests.

2.2.14 Automatic Transmitters

2.2.14.1 Radio Transmitter, Antenna, and Interface Panels

Provide radio transmitter with antenna that is compatible with the existing supervising station fire alarm system. Transmitter shall have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Provide transmitters in accordance with applicable portions of NFPA 72, and Federal Communications Commission (FCC) 47 CFR 90. Protect the antenna from physical damage. Transmitter shall have a source of power for operation which conforms to NFPA 72. Transmitter shall be capable of initiating a test signal daily at any selected time. Wiring shall be per manufacturer requirements and located in PVC coated rigid galvanized steel conduit with water tight fittings.

2.2.14.2 Signals To Be Transmitted to the Base Receiving Station

The following initiation signals shall be sent to the base receiving station:

- a. Manual station alarm
- b. Smoke sensor alarm
- c. Duct smoke sensor alarms
- d. Trouble signals

2.3 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

- a. FACP
- b. Automatic transmitter

Furnish sample of plates to obtain approval by the Contracting Officer before installation. Obtain approval by the Contracting Officer for installation locations. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.4 WIRING

Provide wiring materials under this section as specified in Section 26 20

00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

PART 3 EXECUTION

3.1 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

- a. FACP: Locate the FACP where indicated on the drawings. Surface mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACP.
- b. Manual Stations: Locate manual stations as required by NFPA 101 and NFPA 72. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.
- c. Notification Appliance Devices: Locate notification appliance devices as required by NFPA 72. Mount assemblies on walls 80 inches above the finished floor or 6 inches below the ceiling whichever is lower.
- d. Smoke Sensors: Locate sensors as required by NFPA 72 and their listings on a 4 inch mounting box. Sensors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. Install smoke sensors no closer than 5 feet from air handling supply outlets.
- e. Annunciator: Locate the annunciator where shown on the drawings. Surface mount the panel, with the top of the panel 6 feet above the finished floor or center the panel at 5 feet, whichever is lower.

3.2 DISCONNECTION AND REMOVAL OF EXISTING SYSTEM

Fire alarm control panels and fire alarm devices disconnected and removed shall be turned over to the Contracting Officer.

- a. The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. Once this new system is on-line and accepted by the Government, remove the old system. As new equipment is installed, label it "NOT IN SERVICE." Upon acceptance, remove labels.
- b. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.
- c. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.

3.3 FIRESTOPPING

Coordinate firestopping for holes at conduit penetrations through fire rated walls and partitions with fire rated doors in accordance with Section 07 84 00 FIRESTOPPING.

3.4 PAINTING

Paint fire alarm and junction boxes and conduit red. Painting shall comply with 09 90 00 PAINTS AND COATINGS and UFC 3-600-10N.

3.5 FIELD QUALITY CONTROL

3.5.1 Tests

- a. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.
- b. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- c. Request for Formal Inspection and Tests: When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to the Contracting Officer.
- d. Final Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the Contracting Officer and the following are provided at the job site:
 - (1) The systems manufacturer's technical representative
 - (2) Marked-up red line drawings of the system as actually installed
 - (3) Loop resistance test results
 - (4) Complete program printout including input/output addresses

The final tests shall be witnessed by the Mid-Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer. At this time, any and all required tests shall be repeated at their discretion. Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to the Contracting Officer for review and acceptance. In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M manuals are received.

3.5.2 Minimum System Tests

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

- a. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.
- b. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.
- c. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Testing of duct smoke detectors shall comply with the requirements of NFPA 72.
- d. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.
- e. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.
- f. Determine that the system is operable under trouble conditions as specified.
- g. Visually inspect wiring.
- h. Test the battery charger and batteries.
- i. Verify that software control and data files have been entered or programmed into the FACP. Provide hard copy paper and electronic/disc records of the software to the Contracting Officer.
- j. Verify that red-line drawings are accurate.
- k. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.
- l. Measure voltage readings for circuits to ensure that voltage drop is not excessive.
- m. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke sensors shall be conducted using real smoke. The use of canned smoke is prohibited.
- n. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

3.5.3 Testing Deficiencies

Contractor shall correct deficiencies identified during testing and repeat testing to confirm compliance.

3.6 INSTRUCTION OF GOVERNMENT EMPLOYEES

Equipment manufacturer shall provide on site technical training to the Government. Training shall allow individual hands on programming, troubleshooting and diagnostics exercises. Training shall occur within 2 months of system acceptance.

3.6.1 Instructor

Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm and fire detection system.

3.6.2 Qualifications

Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory as well as in practical O&M work.

3.6.3 Required Instruction Time

Provide 8 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

-- End of Section --

SECTION 35 20 23

DREDGING

04/06

PART 1 GENERAL

NOTE: THE FOLLOWING SPECIFICATION IS A PART OF THE 2013 MAINTENANCE DREDGE CONTRACT, CONTRACT NO. N40085-13-C-8032. WORK TO COMPLETE THIS CONTRACT IS BID OPTION # 5 AND INCLUDES DREDGING IMMEDIATELY IN FRONT OF THE ENTRANCE TO DRY DOCK #3 AS SHOWN ON THE DRAWING PROVIDED. THE DRAWING IS BASED ON A PSOT DREDGE SURVEY COMPLETED IN January OF 2014. ADDITIONAL SILTATION MAY HAVE OCCURRED AND SHALL BE REMOVED TO ACHIEVE THE REQUIRED DEPTH. THE FULL EXTENT OF THE ORIGINAL CONTRACT IS FURTHER DETAILED IN THIS SPECIFICATION AND THE DRAWING SET PROVIDED.

The work of this section includes Contractor's operations at the entrance areas to Dry Docks 1, 2 and 3 (Base Bid work) and at Berth 11B (Bid Option work).

Base Bid Work shall be conducted at Dry Docks 1, 2 and 3, as indicated on drawings and includes acceptance of Government's pre-dredge hydrographic surveys, lobster mitigation, dredging, off-loading, dewatering of dredge spoils, transport of dewatered dredge spoils to Building 357 for processing and approval, transporting dewatered dredge spoils from Building 357 to a licensed landfill (dredge spoils will not be off-loaded at Bldg 357), materials sampling and testing as required by licensed landfill designated for disposal, and post-dredge hydrographic surveys.

Bid Option Work 1 shall be conducted at Berth 11B as indicated on drawings and includes acceptance of Government's pre-dredge hydrographic surveys, lobster mitigation, dredging, off-loading, dewatering of dredge spoils, transport of dewatered dredge spoils to Building 357 for processing and approval, transporting dewatered dredge spoils from Building 357 to a licensed landfill (dredge spoils will not be off-loaded at Bldg 357), materials sampling and testing as required by licensed landfill designated for disposal, and post-dredge hydrographic surveys.

Bid Option Work 2 shall be conducted at a location to be determined and includes acceptance of Government's pre-dredge hydrographic surveys, lobster mitigation, dredging, off-loading, dewatering of dredge spoils, transport of dewatered dredge spoils to Building 357 for processing and approval, transporting dewatered dredge spoils from Building 357 to a licensed landfill (dredge spoils will not be off-loaded at Bldg 357), materials sampling and testing as required by licensed landfill designated for disposal, and post-dredge hydrographic surveys.

1.1 DEFINITION

Hard material is defined as material requiring blasting or the use of special equipment for economical removal, and includes large boulders or fragments too large to be removed in one piece by the dredge plant. Boulders and rock fragments less than 2 tons in weight are not considered hard material. The dredge plant must be capable of removing boulders and rock fragments up to 2 tons in weight.

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-01 Preconstruction Submittals

Construction Operations Plan; G

Hydrographic Survey Methods; G

Letter of Acceptance of Government's Pre-Dredge Hydrographic Survey;
G

Method for Computing Overdredge Quantities; G

Material Sampling and Testing Plan (Base Bid); G

SD-02 Shop Drawings

Dewatering Plan; G

SD-11 Closeout Submittals

Material Test Results; G

Post-dredge Hydrographic Survey; G

Overdredge Quantity Calculations; G

Approved Manifest; G

1.3 MATERIAL TO BE REMOVED

The material to be removed is silt, sand, gravel, cobbles, boulders, artificial obstructions and other dredge materials.

Soil data obtained in 2008 is provided in Appendix B, but reflects material characteristics at that time and is for general information and reference only; it shall not be used as a basis of characterization for disposal under this contract. The contractor is responsible for sampling, testing and characterization of material for disposal.

1.3.1 Hard Material

The removal of hard material is not included. Should the Government direct in writing that hard material be removed, the work shall be performed and an adjustment in the contract price or time for completion, or both, will be made in accordance with "FAR 52.236-2, Differing Site Conditions." If hard material is to be removed, blasting will not be permitted.

If Contractor encounters hard material within the design dredge depths, Contractor shall show to the Government's satisfaction that the material is not excavatable by the equipment used for this project, and shall

identify the limits and elevations of the hard material as directed, at no additional cost to the Government.

1.3.2 Artificial Obstructions

The Government has knowledge of material, including but not limited to, metal bands, pallets, pieces of broken cable, rope, fire hose, concrete blocks, miscellaneous metal, chain, broken piles, etc. The Government has no knowledge of existing ordnance, wrecks, wreckage, or other material of such size or character as to require the use of explosives or special or additional plant for its safe removal. Artificial obstructions excavated from the dredge area shall be placed in the dewatering area separate from the dredge materials, and shall be rinsed for review by the Government. All artificial obstructions shall become the property of the Contractor unless otherwise directed or indicated, and shall be properly disposed of at the end of the project at a Government approved facility, at no additional cost to the Government.

1.4 QUANTITY OF MATERIAL

1.4.1 General

The estimated quantity for bidding purposes and for application of the "FAR 52.212-11, Variation in Estimated Quantity" shall be as shown on Sheet G-002 of the Project drawings. The quantities listed are estimates only. Within the limits of available funds, complete the work specified whether the quantities involved are greater or less than those estimated.

1.4.2 Overdepth Dredging

To cover unavoidable inaccuracies with the dredging process, where overdepth dredging is indicated, material actually removed to a depth of 2 feet below the design dredge depth specified and within the dredging limits will be measured and paid for at the bid unit price. Material excavated below or beyond the limits shown on the drawings will not be measured or included for payment.

1.4.3 Side Slopes

Dredging on side slopes shall follow, as closely as practicable, the lines indicated or specified. A 2 foot allowance will be made for dredging beyond the indicated or specified side slopes, except as provided herein. The amount of material excavated from side slopes will be determined by the approved method for computing dredge quantities.

1.5 PERMIT

The Contractor shall comply with conditions and requirements of the Corps of Engineers Permit and other State or Federal permits. The Contracting Officer will secure the permit for dredging and disposal of material as indicated. The Contractor shall make arrangements with and approved state licensed landfill for disposal of excavated materials.

1.6 CHARGES

The Contractor shall pay all costs associated with the transportation of the dredge materials from the dewatering site to the state licensed landfill, and shall pay all charges required by the landfill for proper disposal of the dredge material.

The Contractor is responsible for all sampling, testing, segregation and processing of the dredge materials required by the state licensed landfill identified for disposal, as required by the State of Maine Department of Environmental Protection Solid Waste Division, and as required by the state in which the landfill is located. Costs for this work shall be included in the lump sum contract price for the Base Bid, and in the lump sum contract price for Bid Option.

1.7 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain during the life of the contract, environmental protective measures. Also, provide environmental protective measures required to correct conditions, such as oil spills or sediment that occur during the dredging operations. Comply with Federal, State, and local regulations pertaining to water, air, erosion and sediment control, and noise pollution.

1.8 BASIS FOR BIDS

Payment will be at the contract unit price per cubic yard, multiplied by total cubic yards of acceptable dredging. Base bids on total cubic yards of dredging indicated. Include a bid unit price per cubic yard of dredging based on the quantity as specified or indicated. If the Contracting Officer requires an increase or a decrease in total volume of dredging, the contract price will be adjusted in accordance with the "FAR 52.211-18, Variation in Estimated Quantity." Dredging conditions specified and indicated describe conditions which are known. However, the Contractor is responsible for other conditions encountered which are not unusual when compared to conditions recognized in the dredging business as usual in dredging activities such as those required under this contract.

1.9 CONSTRUCTION OPERATIONS PLAN

Submit a Construction Operations Plan indicating the proposed method by which the dredge work will be conducted. Describe in detail the means by which dredge operations will be conducted so as to avoid damage to benthic resources outside the dredge area. The plan shall include discussion of the following items:

- a) Type of dredge equipment and vessels to be used throughout the project,
- b) Coordination and communication efforts between site personnel to minimize impact to Portsmouth Naval Shipyard operations,
- c) Maintaining horizontal and vertical survey control,
- d) Proposed means to avoid damage to adjacent structures, vessels, and moorings, and fenders,
- e) Proposed means to avoid over dredging
- f) Proposed methods to effectively dewater and remove all dredge spoils from the dewatering site within the project time limits,
- h) Proposed methods to keep unloading site and all haul routes clean, and
- i) Proposed methods to prevent spillage from trucks.

1.10 DEWATERING PLAN

Submit a Dewatering Plan of the dredge spoils. Dewatering operations shall be conducted on the Contractor's waterborne plant, no land based dewatering site will be provided as part of this contract. The plan shall indicate the steps and methods the Contractor will utilize to ensure the dredge materials are dewatered sufficiently to allow transport and disposal at a licensed solid waste facility within the specified contract completion date. Plan shall indicated means and methods for preventing amended dredge spoils from entering the river. The plan must be stamped and signed by a licensed registered Professional Engineer.

1.11 LAYOUT WORK AND SURVEYS

The Contractor shall employ a licensed surveyor to layout the limits of the work, establish vertical control using approved datums and perform surveys. The Contractor shall provide all buoys, ranges and other controls necessary to accomplish the work and facilitate inspection.

1.12 HYDROGRAPHIC SURVEYS

The Contractor shall submit a Letter of Acceptance of Government's Pre-Dredge Hydrographic Survey shown in the contract drawings prior to commencing dredging operations.

Prior to commencing work, submit hydrographic survey methods to the Contracting Officer's Representative. Hydrographic surveys shall use multi-beam sonar transducers and shall provide 100% bottom coverage including a method to correct for side slope and beam angle error. Survey methodology shall conform to the US Army Corps of Engineers specification EM1110-2-1003. Survey accuracy shall be as follows: horizontal positioning: less than 1 meter; NADIR (vertical): ± 0.15 feet. Plans of the Pre-dredge Hydrographic Survey (Bid Option) shall include a typical section of the proposed dredge area.

1.13 METHOD FOR COMPUTING OVERDREDGE QUANTITIES

Submit Method for Computing Overdredge Quantities. Method must be a generally recognized technique using TIN subtraction method of calculation and must be compatible with AutoCAD Civil 3D 2010 software.

1.14 MATERIAL SAMPLING AND TESTING (BASE BID)

1.14.1 Material Sampling and Testing Plan

Contractor shall conduct additional sampling of the dewatered dredge spoils as required for disposal of the materials in accordance with state and licensed landfill requirements. Submit a Material Sampling and Testing Plan (Base Bid). Contractor shall ensure that a sufficient quantity of samples and tests are performed to meet the state and licensed landfill requirements. The plan shall include sample frequency, sampling methods, compositing methods, testing parameters, detection limits and quality assurance requirements.

1.14.2 Dredge Material Sampling

Samples of the dredge material shall be collected in accordance with the approved Material Sampling and Testing Plan (Base Bid). Sampling will be

in accordance with standard reference procedures from the US Army Corp of Engineers, the State of Maine Department of Environmental Protection Solid Waste Division and the Environmental Protection Agency's publication SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods".

1.14.3 Dredge Material Testing

Testing of the dredge material will be in accordance with the approved material sampling and testing plan, the State of Maine Department of Environmental Protection Solid Waste Division, the approved state licensed landfill, and the state in which it is located. Submit Material Test Results.

1.15 POST-DREDGE HYDROGRAPHIC SURVEY

Submit a Post-dredge Hydrographic Survey and Overdredge Quantity Calculations. Survey methods shall be in accordance with paragraph 1.12. Electronic hydrographic surveys shall be submitted in AutoCAD Civil 3D 2010 format. Drawings shall be drawn at 1 foot contour intervals on 22"x34" size mylar showing the full length of all piers, berths and dry docks where dredging was accomplished. Plans and quantity calculations shall be stamped and signed by a licensed registered Professional Engineer.

1.16 MATERIALS TRANSPORTATION

Contractor shall transport materials from barge to Building 357, and from Building 357 to approved disposal facility, as indicated. All land transportation shall be conducted in watertight trucks to avoid spillage of dredge spoils before and after dewatering. Contractor shall transport dredge spoils from the dewatering site to the designated location at PNSY for manifesting (Building 357) before proceeding to the disposal facility. Contractor shall obtain and submit for each accepted delivery to the disposal facility an Approved Manifest. The Contractor shall confirm the operating hours of Building 357 and coordinate transportation of dewatered dredge spoils with building 357 personnel. All materials shall be transported on the Shipyard between the hours of 8:00AM and 3:00PM Monday through Thursday. The allowable trucking routes on the Shipyard are shown on project drawings.

1.17 WORK AREA

1.17.1 PROTECTION OF EXISTING WATERWAYS AND SHOALS

The Contractor shall conduct his operations in such a manner that the material is not pushed outside of dredging limits or otherwise deposited in existing side channels, basins, docking areas, or other areas being utilized by vessels or moored boats. The Contractor will be required to change his method of operations to comply with the above requirements. Should any bottom material or other dredged material be pushed into areas described above as a result of the Contractor's operations, the material must be promptly removed.

1.17.2 ADJACENT PROPERTY AND STRUCTURES

The Contractor shall conduct the dredging operation such that it does not undermine, weaken, or otherwise impair existing structures located in or near the areas to be dredged. The Contractor shall plan the dredge work accordingly.

Damage to private or public property or structures resulting from the disposal or dredging operations shall be repaired promptly by the Contractor at his expense. Damage to structures resulting from the Contractor's negligence will require prompt repair at the Contractor's expense.

Contractor shall pay special attention to the unloading site and haul routes on Portsmouth Naval Shipyard. Contractor shall employ tailgate locks on trucks or other approved methods to ensure sealing against spillage. Contractor may be required to clean Portsmouth Naval Shipyard haul routes as directed, if the trucks do not prevent spillage of the dredge spoils and water to the satisfaction of the Contracting Officer's Representative.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 LOBSTER MITIGATION

Contractor shall carry out lobster mitigation in accordance with the requirements of the permit and these specifications. Attachment 12 of Appendix A includes a Lobster Mitigation Plan titled "Portsmouth Naval Shipyard (PNSY) Lobster Mitigation Effort - Dry Docks 2 and 3 and Berth 13" dated December 16, 2008 (revised by MER in preparation for the 2008/2009 dredging) which describes the mitigation methodology employed in the past. Contractor shall use this previously approved plan as a general guide to complete mitigation.

Contractor shall carry out lobster mitigation in accordance with the requirements of the permit and these specifications. Attachment 12 of Appendix A includes a Lobster Mitigation Plan titled "Portsmouth Naval Shipyard (PNSY) Lobster Mitigation Effort - Dry Docks 2 and 3 and Berth 13" dated December 16, 2008 (revised by MER in preparation for the 2008/2009 dredging) which describes the mitigation methodology employed in the past. Contractor shall use this previously approved plan as a general guide to complete mitigation.

Trapping shall be of both legal and sub-legal size lobsters. It is acceptable for legal lobsters to be retained by the fisherman assisting with the mitigation effort. Sub-legal lobsters shall be transported to the lobster relocation site indicated on the contract drawings.

In summary, using the previously approved lobster mitigation plan as a guide, the following lobster mitigation plan shall be employed prior to dredging:

- " Conduct lobster trapping at all dredge locations until target C/E is achieved
- " Relocate lobsters to designated area
- " Provide final data and report including effectiveness evaluation and verification that 0.5 l/t/ns has been achieved.

The contractor shall employ the services of a qualified professional to manage/perform all phases of the lobster mitigation effort. The qualified professional shall be familiar with the Maine Department of Marine

Resources requirements, protocols and procedures related to lobster mitigation, trapping, and transport. The person(s) performing trapping activities must be properly licensed in the State of Maine for all activities associated with the lobster mitigation efforts. Submit all reports and data for Government review and acceptance prior to start of dredge operations.

3.2 STURGEON AND SALMON MONITORING

The contractor shall provide all labor and personnel required to monitor dredging activity for entrapment/ensnarement of Atlantic and/or short-nosed sturgeon species, as well as Atlantic salmon. A monitor shall be present at all times while dredging is ongoing. The monitor shall be positioned in a location where dredge spoils can be easily observed. If any of the species of concern become entrapped/ensnared in dredge bucket or spoils, all work shall cease, the fish shall be immediately released back to the river, and the NAVFAC PWD-ME Natural Resource Manager (NRM) shall be contacted. Work shall not commence until the NRM receives written concurrence from the National Marine Fisheries Service. The contractor shall meet with the NRM prior to execution of dredge work for fish species identification, handling, and documentation guidance. The contractor shall assume 1 hour of meeting attendance time for this task and the meeting shall be attended by all employees that will be performing the monitoring. Designated monitor may also perform duties of QCM or SSHO.

3.3 INSPECTION

Inspect the work, keep records of work performed, and ensure that gages, targets, ranges, and other markers are in place and usable for the intended purpose. Furnish, at the request of the Contracting Officer, boats, boatmen, laborers, and materials necessary for inspecting, supervising, and surveying the work. When required, provide transportation for the Contracting Officer and inspectors to and from the disposal area and between the dredging plant and adjacent points on shore.

3.4 CONDUCT OF DREDGING WORK

3.4.1 Order of Work

The following table presents a tentative dredge sequencing schedule based upon PNS boat docking dates (Coast Guard and SSN). Contractor shall confirm docking schedules and adjust the sequencing as required to accommodate PNS scheduling requirements.

<u>Tentative Dredging Timeframes (2013-2014)</u>		
Location	Est. Quantity*	Dates
Dry Dock 3	1,424 CY	01 DEC - 20 DEC
PSB Anchor 3	312 CY	20 DEC - 17 JAN
Dry Dock 1 & Berth 11B	1,126 CY	17 JAN - 31 JAN

<u>Tentative Dredging Timeframes (2013-2014)</u>		
Dry Dock 2	1,850 CY	03 FEB - 28 FEB
Location TBD (Bid Opt 2)	1,200 CY	28 FEB - 14 MAR

*Amount includes overdredge allowance.

The Contracting Officer's Representative will direct the Contractor on the order of work. The Government reserves the right to change the order of work at any time.

Under no circumstances shall any dredging work occur before November 15, 2013 or after March 15, 2014 as specified in the project permits.

3.4.2 Interference with Navigation

Contractor shall coordinate all marine vessel movements with the Shipyard's Port Operations Department. The Contractor shall submit a weekly updated schedule showing proposed dredge locations and vessel movements to the Contracting Officer's Representative. The Contractor shall meet with Contracting Officer's Representative and Shipyard Port Operations Representatives weekly to review the schedule.

The Contractor shall minimize interference with the use of channels and passages. The Contracting Officer's Representative will direct the shifting or moving of dredges or the interruption of dredging operations to accommodate the movement of vessels and floating equipment, if necessary.

Contractor shall maintain a minimum of 50' of standoff from any berthed submarine and a minimum of 25' from any berthed barge or support vessel.

3.4.2.1 Compensation for Interruption of Operations

If dredging operations are interrupted due to the movement of vessels or floating equipment, an adjustment in the contract price or time for completion, or both, will be made as provided by the contract. The Contracting Officer will notify the Contractor 7 days prior to ship movements that will affect dredging operations.

3.4.3 Lights

Each night, between sunset and sunrise and during periods of restricted visibility, provide lights for floating plants, pipelines, ranges, and markers. Also, provide lights for buoys that could endanger or obstruct navigation. When night work is in progress, maintain lights from sunset to sunrise for the observation of dredging operations. Lighting shall conform to United States Coast Guard requirements for visibility and color.

3.4.4 Ranges, Gages, and Lines

Furnish, set, and maintain ranges, buoys, and markers needed to define the work and to facilitate inspection. Establish and maintain gages in locations observable from each part of the work so that the depth may be determined. Suspend dredging when the gages or ranges cannot be seen or followed.

3.4.5 Plant

Maintain the plant, scows, coamings, barges, pipelines, and associated equipment to meet the requirements of the work. Promptly repair leaks or breaks along pipelines. Remove dredged material placed due to leaks and breaks.

3.4.6 Disposal of Excavated Material

Provide for safe transportation and disposal of dredged materials to building 357, and from the Building 357 to the approved landfill. Transportation shall include measures to prevent loss of material during movement, including water that might separate from the dredge spoils during movement. Contractor is responsible to follow all haul restrictions and requirements imposed by the towns or municipalities in which the haul routes are located. The deposit of dredged materials in unauthorized places is forbidden.

3.4.7 Method of Communication

Provide a system of communication between the dredge crew, the Port Operations of the Portsmouth Naval Shipyard and the crew at the disposal area. A portable two-way radio is acceptable.

3.4.8 Salvaged Material

Anchors, chains, firearms, ordnance and other articles of value, which are brought to the surface during dredging operations, shall remain or become the property of the Government.

3.4.9 Safety of Structures

The prosecution of work shall ensure the stability of caissons, piers, berths, bulkheads, fender systems, mooring hardware, and other structures lying on or adjacent to the site of the work, insofar as structures may be jeopardized by dredging operations. Repair damage resulting from dredging operations.

3.4.10 Plant Storage

When not in use, plant equipment shall be stored at an approved location. Stored plant equipment shall not interfere with Portsmouth Naval Shipyard operations.

3.4.11 Plant Removal

Upon completion of the work, promptly remove plant, including ranges, buoys, piles, and other markers or obstructions.

3.5 MEASUREMENT

Contractor shall take soundings before and after dredging.

3.5.1 Method of Measurement

The material removed will be measured by cubic yard in place, by means of soundings taken before and after dredging. The drawings represent existing conditions based on current available information, but shall be verified and corrected, if necessary, by soundings taken before dredging

in each locality. Soundings shall be taken by Multi-Beam Sonar methods, as approved by the Contracting Officer; results of soundings by either or both methods will be the basis for payment.

3.5.2 Surveys During Progress of Work

Contract depth will be determined by sounds as work progresses. The Contractor shall take progress soundings. Contractor shall be able to produce drawings with soundings data at any time during dredging operations if requested by the Contracting Officer.

3.5.3 Monthly Estimates

Monthly estimates of work completed will be based on the result of soundings taken during the progress of the work. Deductions will be made for dredging and disposal not in accordance with the specifications.

3.6 FINAL EXAMINATION AND ACCEPTANCE

Contractor shall ensure that existing drains, catch basins, and drainage structures used in the vicinity of the offload site are protected and free of sediment and debris, and freely transport water to the outfalls.

When areas are found to be in a satisfactory condition, the work therein will be accepted as complete. Final estimates will be subject to deductions or correction of deductions previously made because of excessive overdepth, dredging outside or authorized areas, or disposal of material in an unauthorized manner.

-- End of Section --

PORTSMOUTH NAVAL SHIPYARD KITTERY, ME

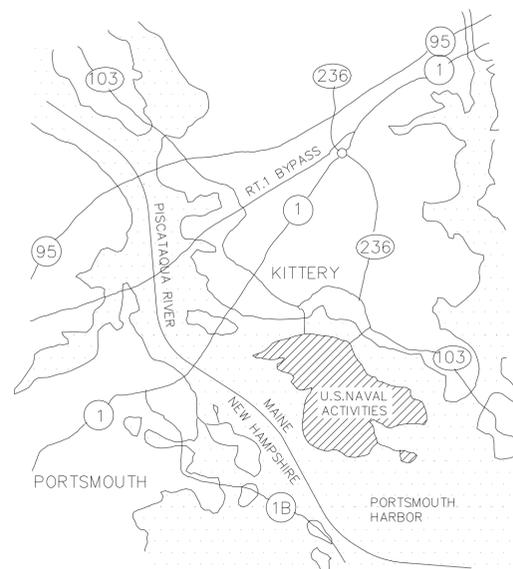
2013 MAINTENANCE DREDGING CONTRACT NO. N40085-13-C-8032

LIST OF DRAWINGS

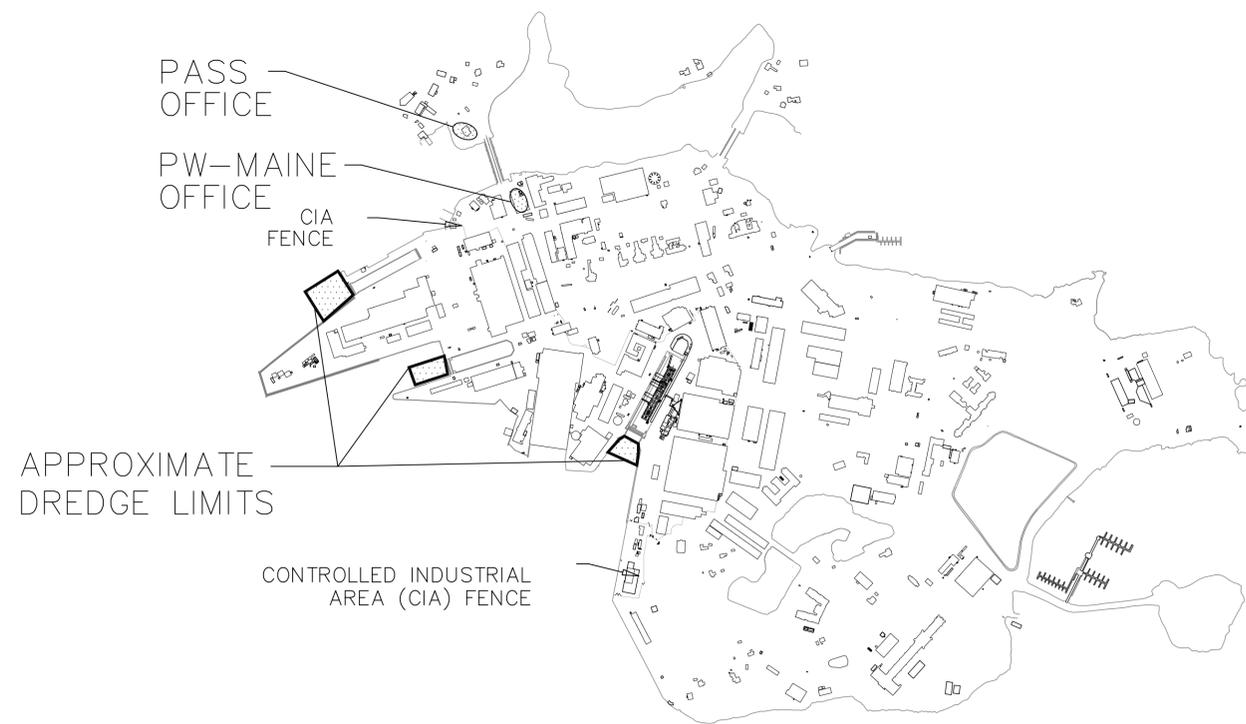
SHEET NO.	PWD-ME DWG. NO.	NAVAC DWG. NO.	DRAWING TITLE
1 OF 6	G-001	12646973	TITLE SHEET
2 OF 6	G-002	12646974	PROJECT NOTES
3 OF 6	C-101	12646975	OVERALL PLAN
4 OF 6	C-102	12646976	DRY DOCK #3 DREDGE PLAN
5 OF 6	C-103	12646977	DRY DOCK #1 DREDGE PLAN
6 OF 6	C-104	12646978	DRY DOCK #2 DREDGE PLAN



AREA MAP

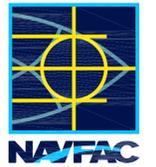
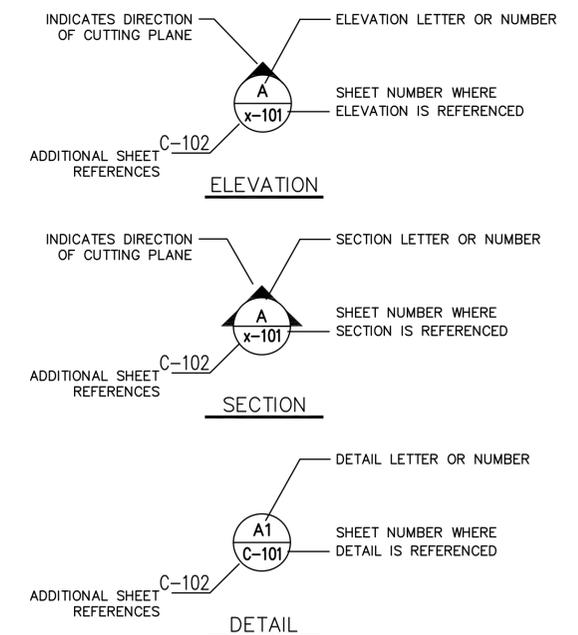


VICINITY MAP



SITE PLAN
SCALE: 1" = 600'

ELEVATION, SECTION OR DETAIL SYMBOLS



PWD-MAINE
IN HOUSE DESIGN

APPROVED

FIR COMMANDER NAVAC

ACTIVITY

SATISFACTORY TO DATE

DES TB | DRAW REH | CHK JFH

PA/DM T. BAKER

BRANCH MANAGER J.HOYT

CHIEF ENG/ARCH A.K.BAHRROUR PM&E

FIRE PROTECTION

NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND ~ MID-ATLANTIC

PUBLIC WORKS DEPARTMENT - MAINE

NAVAL SHIPYARD - PORTSMOUTH, ME

PORTSMOUTH NAVAL SHIPYARD

KITTERY, MAINE

2013 MAINTENANCE DREDGING

TITLE SHEET

DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

PUBLIC WORKS DEPARTMENT - MAINE

NAVAL SHIPYARD - PORTSMOUTH, ME

PORTSMOUTH NAVAL SHIPYARD

KITTERY, MAINE

2013 MAINTENANCE DREDGING

TITLE SHEET

MAXIMO NO.: 5775368

PROJECT NO.: 1167427

CONSTR. CONTR. NO. N40085-13-C-8032

NAVAC DRAWING NO. 12646973

SHEET 1 OF 6

G-001 BS-13-206

DRAWFORM REVISION: 10 MARCH 2009

FILE NAME: P:\Maine\Portsmouth_Naval_Shipyard\Projects\2013_1167427_PNSY_Maintenance_Dredging\B.Design\Drawings\Construction Drawings\FY13_Hydro_Tidal_Map.dwg LAYOUT NAME: C-101 PLOTTED: Wednesday, May 29, 2013 - 10:15am USER: trevis.baker1



GATE 1
TO RT 1 BYPASS
I-95 SOUTH

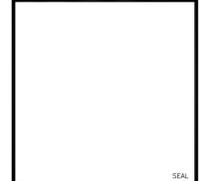
GATE 2
TO RT 236
I-95 NORTH

SURVEY CONTROL POINT TABLE

Point #	Northing	Easting
h-17	89336.00	2799981.12
h-18	89862.14	2800099.02
h-19	90316.36	2800183.31
h-37	91174.51	2798206.10
h-38	91025.12	2798013.45
h-39	90779.93	2798086.75
h-40	90931.89	2798551.66
h-44	90423.38	2799854.26
h-45	90886.49	2798878.10
b-12e	90785.07	2798186.64
bm 13a	90897.55	2797834.24
bm-21	90591.59	2799224.58

HORIZONTAL DATUM IS BASED ON THE MAINE WEST (LAMBERT) STATE PLANE COORDINATE SYSTEM, ZONE 1802M U.S. SURVEY FEET (NAD83).

DATE	DESCRIPTION	BY	APPR
25-24-2013	ISSUED FOR CONSTRUCTION	A	



**PWD-MAINE
IN HOUSE DESIGN**

APPROVED: _____
 FIR COMMANDER NAVFAC

ACTIVITY: _____

SATISFACTORY TO: DATE: MM/DD/YY

DES: TB | DRAW: REH | CHK: CHK | JFH

PA/DM: T. BAKER

BRANCH MANAGER: J. HOYT

CHIEF ENG/ARCH: DWG

FIRE PROTECTION: _____

NAVAL FACILITIES ENGINEERING COMMAND
 NAVAL FACILITIES ENGINEERING COMMAND - MID-ATLANTIC
 PUBLIC WORKS DEPARTMENT - MAINE
 PORTSMOUTH NAVAL STATION
 KITTERY, MAINE

2013 MAINTENANCE DREDGING

OVERALL PLAN

MAXIMO NO.: 5775368

PROJECT NO.: 1167427

CONSTR. CONTR. NO.: N40085-13-C-8032

NAVFAC DRAWING NO.: 12646975

SHEET 3 OF 6

C-101 BS-13-208

DRAWING REVISION: 10 MARCH 2009

DREDGE LOCATION (TYP).
SEE INDIVIDUAL SHEETS FOR PRECISE LIMITS

PORT SECURITY BARRIERS (PSB'S)

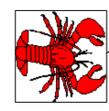
PSB ANCHOR #3

DREDGE LOCATIONS (TYP).
SEE INDIVIDUAL SHEETS FOR PRECISE LIMITS

PORT SECURITY BARRIERS (PSB'S)

TRUCK ROUTE (TYP)

APPROX. DREDGE OFFLOAD AREA. SEE DISPOSAL NOTE #2 ON SHEET G-002.

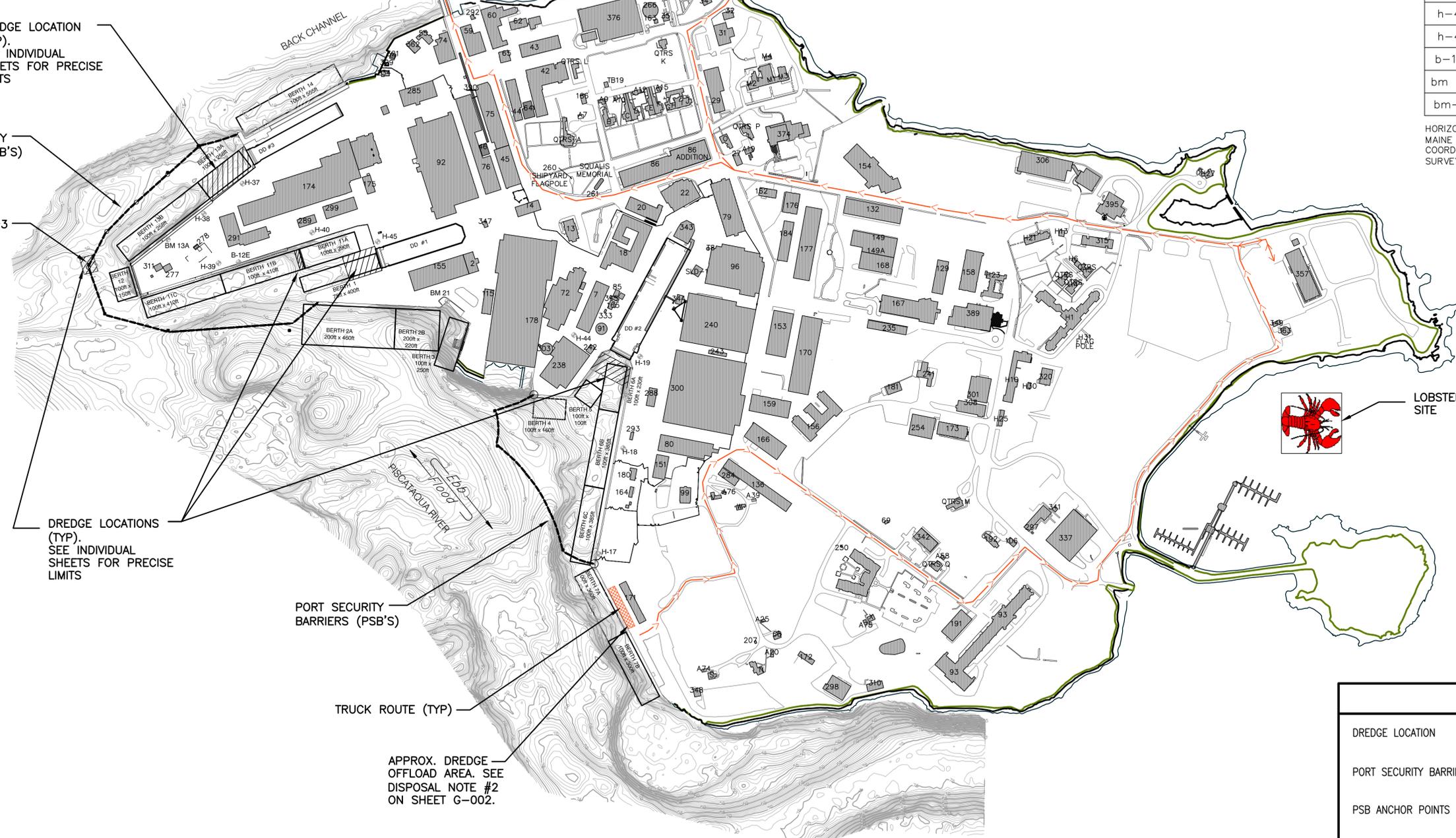


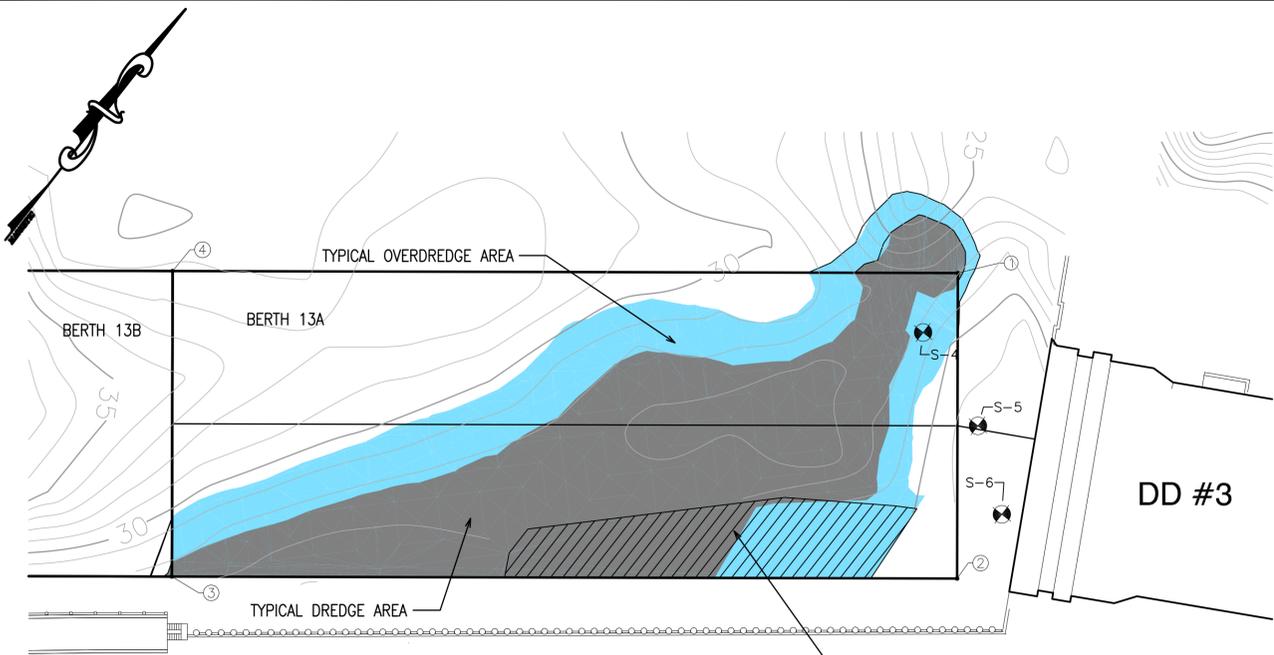
LOBSTER RELOCATION SITE

LEGEND

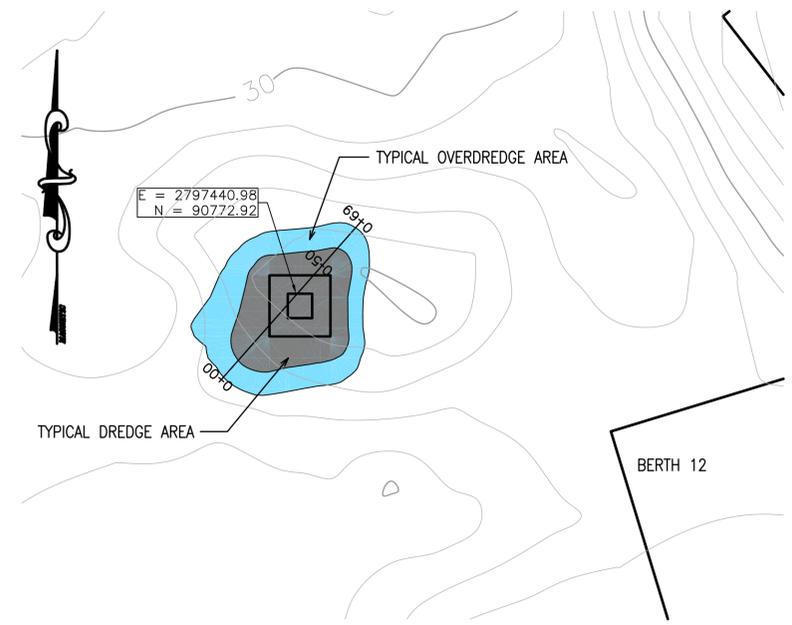
DREDGE LOCATION	
PORT SECURITY BARRIERS (PSB'S)	
PSB ANCHOR POINTS	
DREDGE OFFLOAD AREA	
TRUCK ROUTE	
LOBSTER RELOCATION SITE	

OVERALL PNSY PLAN
SCALE 1" = 300'

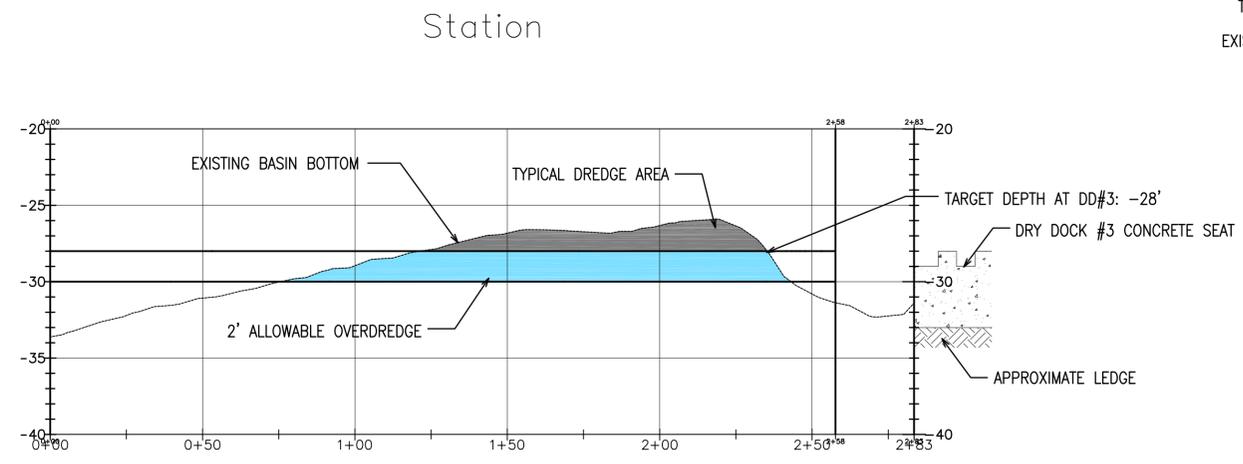




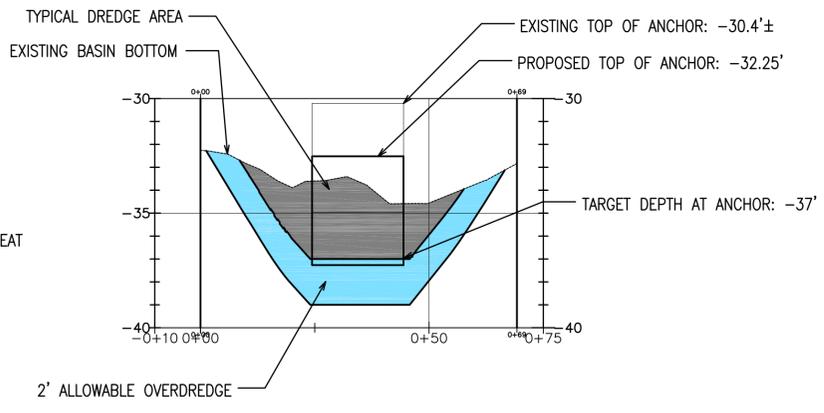
DD #3 PLAN
SCALE 1" = 30'



ANCHOR #3 AT BERTH 12 PLAN
SCALE 1" = 30'



DD #3 PROFILE
HORIZONTAL SCALE 1" = 30'
VERTICAL SCALE 1" = 6'



ANCHOR #3 AT BERTH 12 PROFILE
HORIZONTAL SCALE 1" = 30'
VERTICAL SCALE 1" = 6'

NOTES:

- CONDUCT LOBSTER MITIGATION AT DREDGE SITES AS REQUIRED BY SPECIFICATION SECTION 35 20 23 - DREDGING.
- DEPTHS INDICATED ARE BASED ON MEAN LOW LOWER WATER DATUM AT ELEVATION 0.00'. HORIZONTAL CONTROL COORDINATES ARE BASE ON MAINE WEST STATE PLANE NAD83 U.S. SURVEY FEET.
- CONTRACTOR SHALL REMOVE ALL MATERIAL (EXCLUDING HARD BOTTOM IF ENCOUNTERED) TO TARGET DREDGE DEPTH. OVERDREDGE ALLOWANCE IS PROVIDED TO ACCOUNT FOR INHERENT INACCURACY IN DREDGE PROCESS. PAYMENT WILL NOT BE PROVIDED FOR REMOVALS BEYOND OVERDREDGE DEPTH.

DD #3

DREDGE QUANTITIES

	VOLUME	AREA
ESTIMATED DREDGE VOLUME TO DESIGN DEPTH	346 CY	10,882 SF
ESTIMATED MAXIMUM OVERDREDGE VOLUME	1,078 CY	17,615 SF

ANCHOR #3

DREDGE QUANTITIES

	VOLUME	AREA
ESTIMATED DREDGE VOLUME TO DESIGN DEPTH	86 CY	1,304 SF
ESTIMATED MAXIMUM OVERDREDGE VOLUME	224 CY	2,523 SF

BASIN COORDINATES

Point #	Northing	Easting
1	91338.77	2798185.88
2	91259.81	2798247.24
3	91101.68	2798043.77
4	91180.64	2797982.41

SAMPLE COORDINATES

Point #	Northing	Easting
s-4	91316.41	2798188.87
s-5	91303.42	2798221.87
s-6	91285.42	2798245.87

LEGEND

- 5' HYDROGRAPHIC CONTOUR INTERVAL
- 1' HYDROGRAPHIC CONTOUR INTERVAL
- LIMITS OF BERTH
- APPROXIMATE LIMITS OF DESIGN DREDGE
- TYPICAL DREDGE AREA
- TYPICAL OVERDREDGE AREA
- ANCHOR #3
- BASIN COORDINATE POINT
- SAMPLE COORDINATE POINT

SYMBOL	DESCRIPTION	DATE	BY	APPR
A	ISSUED FOR CONSTRUCTION	05-24-13	JFH	APPR



PWD-MAINE
IN HOUSE DESIGN

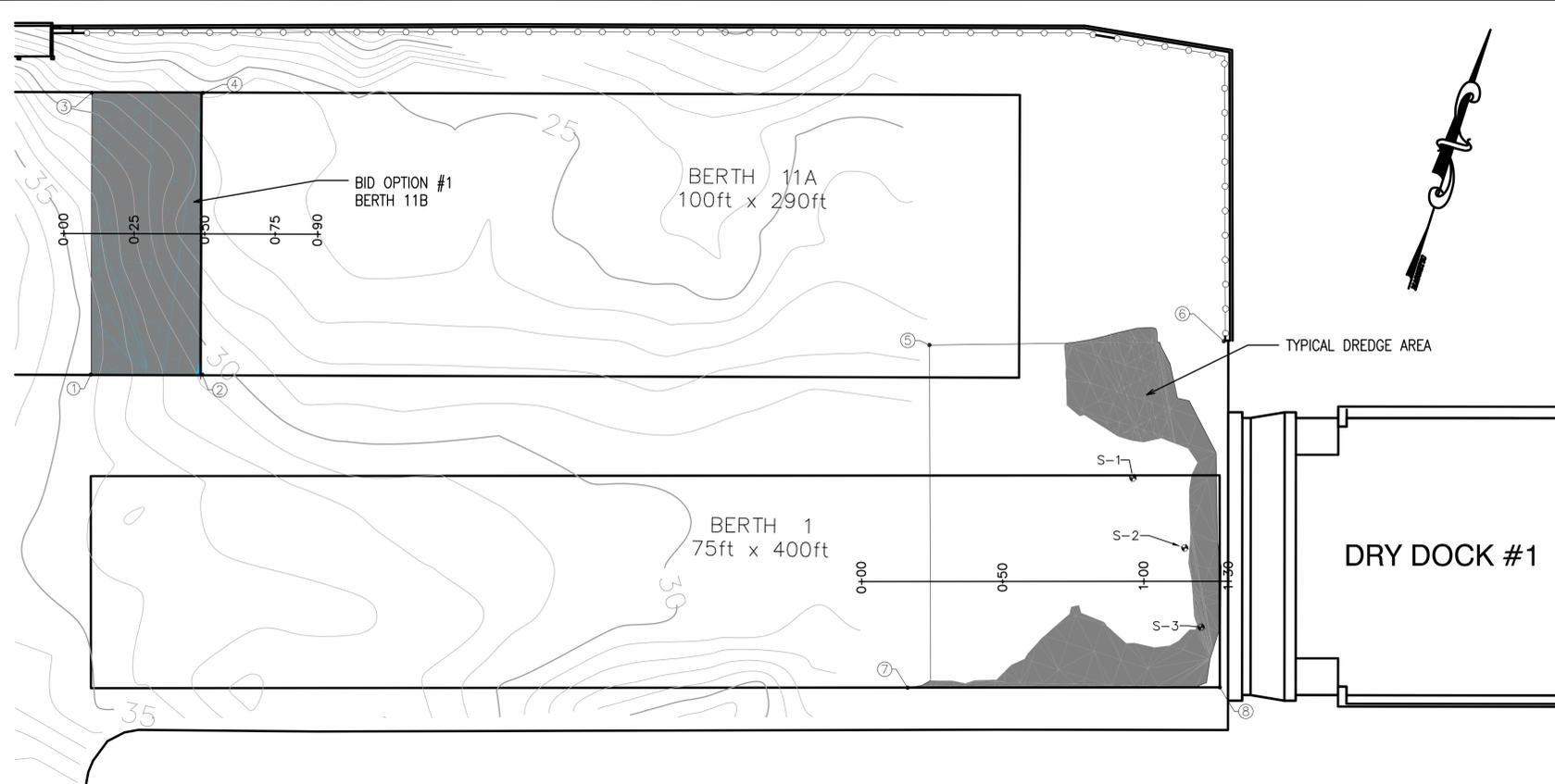
APPROVED	
FIR COMMANDER NAVFAC	
ACTIVITY	
SATISFACTORY TO	DATE MM/DD/YY
DES TB	DRW REH CHK JFH
PA/DM	T. BAKER
BRANCH MANAGER	J. HOYT
CHIEF ENG/ARCH	DWG
FIRE PROTECTION	

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND - MID-ATLANTIC
PUBLIC WORKS DEPARTMENT - MAINE
Portsmouth Naval Shipyard
Kittery, Maine
2013 MAINTENANCE DREDGING
DD#3 DREDGING PLAN

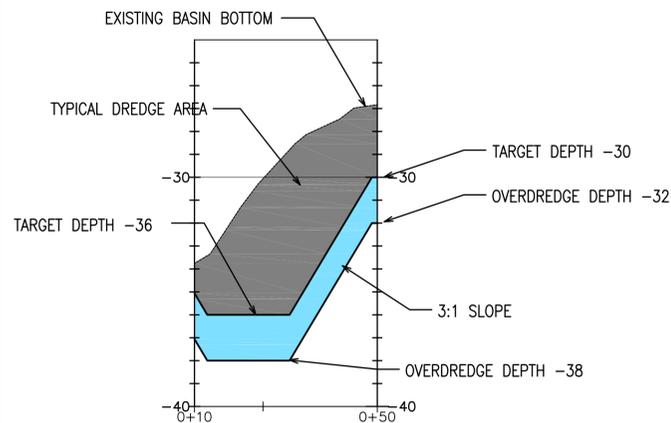
MAXIMO NO.	5775368
PROJECT NO.	1167427
CONSTR. CONTR. NO.	N40085-13-C-8032
NAVFAC DRAWING NO.	12646976
SHEET	4 OF 6

C102 BS-13-209
DRAWFORM REVISION: 10 MARCH 2009

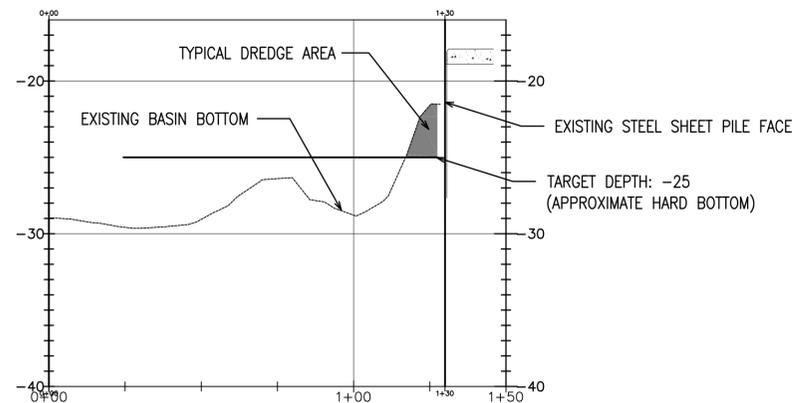
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DRY DOCK #1 PLAN VIEW
SCALE 1"=30'



BERTH 11 B PROFILE VIEW
SCALE 1"=30'



DRY DOCK #1 PROFILE VIEW
SCALE 1"=30'

NOTES:

- CONDUCT LOBSTER MITIGATION AT DREDGE SITES AS REQUIRED BY SPECIFICATION SECTION 35 20 23 - DREDGING.
- DEPTHS INDICATED ARE BASED ON MEAN LOW LOWER WATER DATUM AT ELEVATION 0.00'. HORIZONTAL CONTROL COORDINATES ARE BASE ON MAINE WEST STATE PLANE NAD83 U.S. SURVEY FEET.
- CONTRACTOR SHALL REMOVE ALL MATERIAL (EXCLUDING HARD BOTTOM IF ENCOUNTERED) TO TARGET DREDGE DEPTH. OVERDREDGE ALLOWANCE IS PROVIDED TO ACCOUNT FOR INHERENT INACCURACY IN DREDGE PROCESS. PAYMENT WILL NOT BE PROVIDED FOR REMOVALS BEYOND OVERDREDGE DEPTH.

DD #1

DREDGE QUANTITIES

	VOLUME	AREA
ESTIMATED DREDGE VOLUME TO DESIGN DEPTH	262 CY	3,448 SF

BID OPTION #1 BERTH 11B

DREDGE QUANTITIES

	VOLUME	AREA
ESTIMATED DREDGE VOLUME TO DESIGN DEPTH	630 CY	2,277 SF
ESTIMATED MAXIMUM OVERDREDGE VOLUME	270 CY	

BASIN COORDINATES

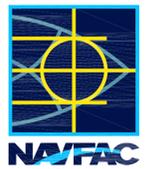
Point #	Northing	Easting
1	90741.65	2798477.86
2	90753.57	2798515.50
3	90836.71	2798447.97
4	90848.63	2798485.61
5	90841.46	2798757.93
6	90874.27	2798856.96
7	90723.61	2798787.19
8	90757.16	2798892.62

SAMPLE COORDINATES

Point #	Northing	Easting
s-1	90818.43	2798840.87
s-2	90800.43	2798865.87
s-3	90775.43	2798879.87

LEGEND

- 5' HYDROGRAPHIC CONTOUR INTERVAL
- 1' HYDROGRAPHIC CONTOUR INTERVAL
- DESIGN DREDGE SIDE SLOPE
- LIMITS OF BERTH
- APPROXIMATE LIMITS OF DESIGN DREDGE
- TYPICAL DREDGE AREA
- TYPICAL OVERDREDGE AREA
- ANCHOR POINTS
- BASIN COORDINATE POINT
- SAMPLE COORDINATE POINT



PWD-MAINE
IN HOUSE DESIGN

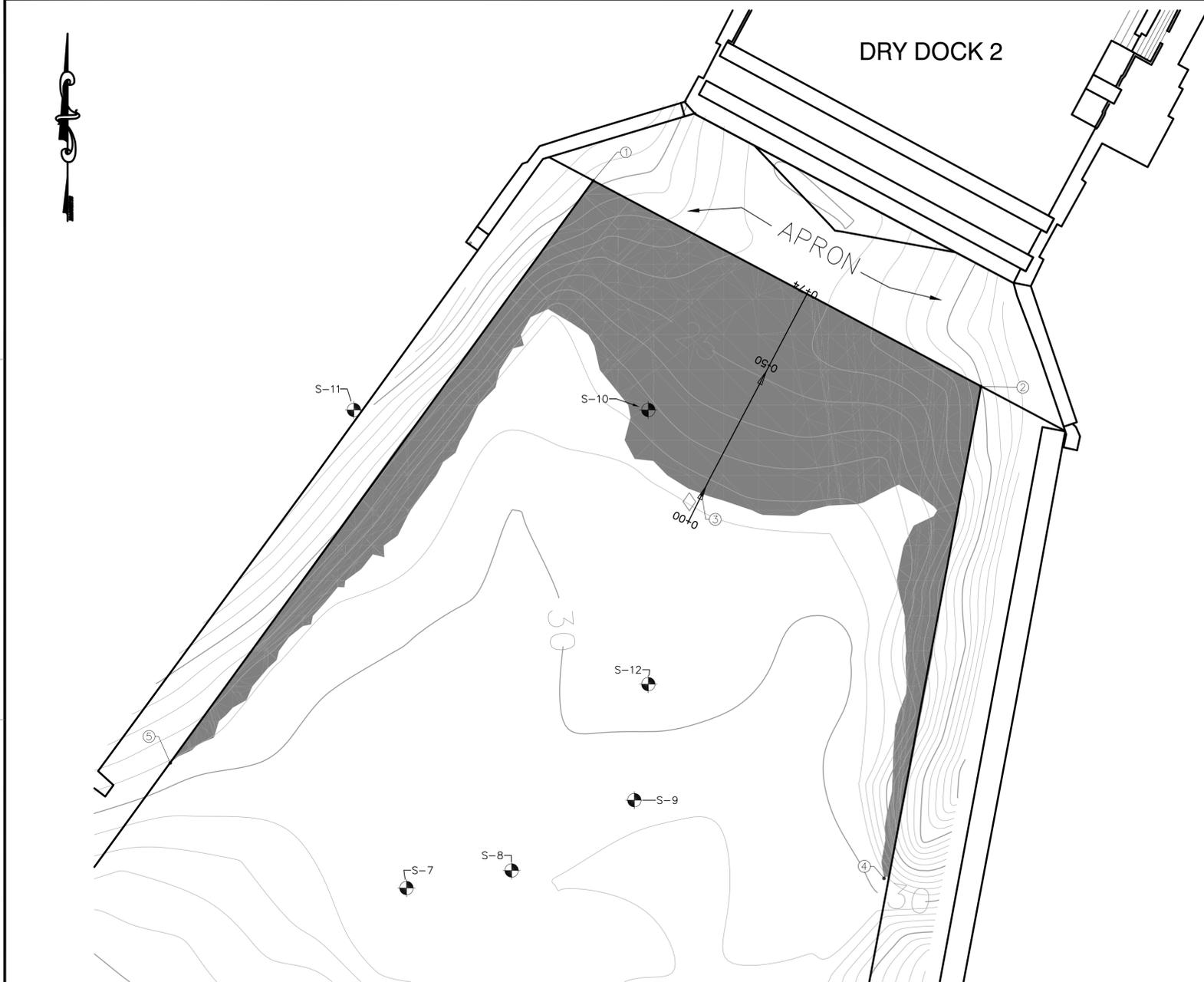
DES	TB	DRW	REH	CHK	JFH
PA/DM	T. BAKER				
BRANCH MANAGER	J. HOYT				
CHIEF ENG/ARCH	DWG				

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
PUBLIC WORKS DEPARTMENT - MAINE
NAVAL SHIPYARD - PORTSMOUTH, MAINE
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE
2013 MAINTENANCE DREDGING
DD #1 DREDGE PLAN

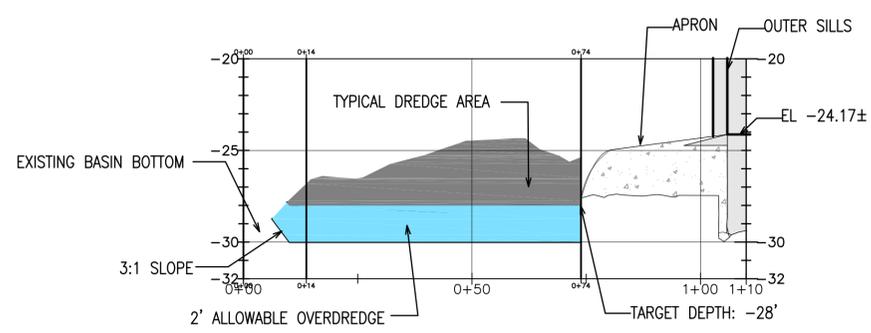
MAXIMO No.:	5775368
PROJECT NO.:	1167427
CONSTR. CONTR. NO.:	N40085-13-C-8032
NAVFAC DRAWING NO.:	12646977
SHEET	5 OF 6

C-103 BS-13-210
DRAWFORM REVISION: 10 MARCH 2009

FILE NAME: D:\Documents and Settings\rosahill\My Documents\Drawings\Projects\Design Projects\Dredging 2012\Construction drawings\DD1.dwg LAYOUT NAME: C-103 PLOTTED: Tuesday, May 28, 2013 - 9:15am USER: rosahill



DRY DOCK #2 PLAN
SCALE 1" = 20'



DRY DOCK #2 PROFILE
HORIZONTAL SCALE 1" = 20'
VERTICAL SCALE 1" = 4'

NOTES:

1. CONDUCT LOBSTER MITIGATION AT DREDGE SITES AS REQUIRED BY SPECIFICATION SECTION 35 20 23 - DREDGING.
2. DEPTHS INDICATED ARE BASED ON MEAN LOW LOWER WATER DATUM AT ELEVATION 0.00'. HORIZONTAL CONTROL COORDINATES ARE BASE ON MAINE WEST STATE PLANE NAD83 U.S. SURVEY FEET.
3. CONTRACTOR SHALL REMOVE ALL MATERIAL (EXCLUDING HARD BOTTOM IF ENCOUNTERED) TO TARGET DREDGE DEPTH. OVERDREDGE ALLOWANCE IS PROVIDED TO ACCOUNT FOR INHERENT INACCURACY IN DREDGE PROCESS. PAYMENT WILL NOT BE PROVIDED FOR REMOVALS BEYOND OVERDREDGE DEPTH.

DD #2

DREDGE VOLUMES ESTIMATES

	VOLUME	AREA
ESTIMATED DREDGE VOLUME TO DESIGN DEPTH	888 CY	9,195 SF
ESTIMATED MAXIMUM OVERDREDGE VOLUME	962 CY	

BASIN COORDINATES

Point #	Northing	Easting
1	90329.70	2800009.15
2	90271.15	2800119.74
3	90240.37	2800040.13
4	90131.22	2800092.10
5	90164.05	2799888.48

SAMPLE COORDINATES

Point #	Northing	Easting
s-7	90128.46	2799955.87
s-8	90133.46	2799985.87
s-9	90153.46	2800020.86
s-10	90264.46	2800024.86
s-11	90264.45	2799940.86
s-12	90186.46	2800024.86

LEGEND

- 5' HYDROGRAPHIC CONTOUR INTERVAL
- 1' HYDROGRAPHIC CONTOUR INTERVAL
- DESIGN DREDGE SIDE SLOPE
- LIMITS OF BERTH
- APPROXIMATE LIMITS OF DESIGN DREDGE
- TYPICAL DREDGE AREA
- TYPICAL OVERDREDGE AREA
- ANCHOR POINTS
- BASIN COORDINATE POINT
- SOIL SAMPLE COORDINATE

DATE	DESCRIPTION	BY	APPR
05-24-13	ISSUED FOR CONSTRUCTION	JFH	
		A	



PWD-MAINE
IN HOUSE DESIGN

APPROVED
FOR COMMANDER NAVFAC

SATISFACTORY TO DATE

DES	TB	DRW	REH	CHK	JFH
					T. BAKER
					J. HOYT
					DWG

FIRE PROTECTION

NAVAL FACILITIES ENGINEERING COMMAND
MID-ATLANTIC REGIONAL SHIPYARD - PORTSMOUTH, NH
KITTERY, MAINE

2013 MAINTENANCE DREDGING

DRY DOCK #2 DREDGE PLAN

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND - MAINE
PUBLIC WORKS DEPARTMENT - MAINE
PORTSMOUTH NAVAL SHIPYARD

MAXIMO No.: 5775368

PROJECT NO.: 1167427

CONSTR. CONTR. NO. N40085-13-C-8032

NAVFAC DRAWING NO. 12646978

SHEET 6 OF 6

C-104 BS-13-211

DRAWFORM REVISION: 10 MARCH 2009

FILE NAME: D:\Documents and Settings\rosahilla\My Documents\Drawings\PNCA\Design Projects\Dredging 2012\Construction drawings\DD2.dwg LAYOUT NAME: C-104 PLOTTED: Tuesday, May 28, 2013 - 9:13am USER: rosahilla

SECTION 35 59 13.16

MARINE FENDERS

05/11

PART 1 GENERAL

Work under this section covers the plastic fenders as shown on the contract drawings and specified herein.

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 D4329	(2013) Standard Practice for Fluorescent UV Exposure of Plastics
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D695	(2010) Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D792	(2013) Density and Specific Gravity (Relative Density) of Plastics by Displacement

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

Fender System; G

SD-07 Certificates

Plastic Lumber; G

Submit plastic lumber certificates and delivery inspection checklist. Field inspect and submit verification list for each member indicating condition of plastic.

1.3 DELIVERY, HANDLING AND STORAGE

Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage. Protect fenders from exposure to damaging

liquids, oils, greases and extended exposure to sunlight. Close-stack plastic lumber in storage to prevent from falling and becoming damaged. Store plastic lumber above the ground on blocking which is shaped or padded and prevent scarring or sagging. Storage racks shall be arranged to permit air circulation. Plastic lumber shall be lowered to dunnage with crane or fork lift. Plastic lumber shall not be rolled off tines of forklift.

1.3.1 Rejection

Fenders that are delivered to the site in a damaged condition or that are not in conformance with this specification are subject to rejection. Any rejected materials shall be replaced with suitable materials, at no additional cost to the Government.

1.4 QUALITY ASSURANCE

1.4.1 Fender System

Fender elements shall be homogeneous and free from any defects, impurities, pores or cracks.

PART 2 PRODUCTS

2.1 PLASTIC LUMBER

Provide composite plastic lumber manufactured as specified. All plastic lumber shall be the product of a single manufacturer. Lumber shall be full size and in one piece. Splices are not allowed. Lumber shall be solid and homogenous throughout, without uncured material, air voids, pockets, segregated raw material, splits, cracks or fusion lines, crooks, twists, warps, or sweeps. All plastic lumber shall be delivered to the work site complete and ready to install.

Plastic shall be a mixture of one or more of the following thermoplastics: high density polyethylene, polypropylene and low density polyethylene with a minimum of 4.0 percent (by weight) carbon black. No used or rebuilt structural elements shall be used in the fabrication of the plastic lumber.

The minimum properties of the plastic shall be as follows:

Density (ASTM D792)	51.5 lb/cu.ft. minimum
Modulus of Elasticity	45,000 psi minimum
Max Yield Stress in Bending	Fb=850 psi
Compressive Modulus	45,000 psi minimum
Compressive Strength (ASTM D695)	1,750 psi minimum
Ultimate Tensile Strength (ASTM D638)	500 psi minimum
Water Absorption (ASTM D570)	Less than 3 percent weight increase in 24 hours
Ultraviolet (ASTM D4329 B Lamp)	No more than 10 percent change in Shore D

durometer hardness after
500 hours exposure

PART 3 EXECUTION

3.1 FIELD INSTALLATION AND QUALITY CONTROL

Field-treat cuts, bevels, notches, holes, refacing, and abrasions made in the field in accordance with the manufacturer's instructions.

Each member shall be measured for straightness prior to installation. The line shall lie entirely within the body of the lumber. Plastic umber not meeting these criteria shall be rejected. Each reinforced member shall be inspected for cracks prior to installation. Prior to final acceptance, each reinforced member shall again be inspected for cracks. Cracking of the plastic lumber shall be cause for rejection. The Contractor shall be responsible for all costs incurred to replace the rejected plastic members.

All holes and counter bores for fender bolt heads shall be drilled true and straight and shall match the holes in the steel wale. Location of holes shall not be greater than +/-1/4 inch from specified locations. Bolt holes shall not exceed bolt diameter plus 1/16 inch.

All bolts shall be tight prior to final acceptance. Provide all bolts with sufficient additional threads to permit at least 1/2 inch per foot thickness of timber for future retightening. Accurately cut and frame all lumber and timber so that the joints will have a tight fit over the entire contact surfaces. No shimming will be permitted in making joints, nor will open joints be accepted. Members shall be in tight with full contact.

-- End of Section --

SECTION 43 21 39.00 20

OVERHAUL AND REFURBISHMENT OF EXISTING VERTICAL TURBINE MAIN DEWATERING PUMPS
12/14

PART 1 GENERAL

1.1 SUMMARY

This section specifies the requirements for the overhaul and refurbishment of existing main dewatering pumps (MDP-1 and MDP-2) for Dry Dock #3 located in Pump Well #3. Refer to Attachment "A" for the "Scope of Overhaul and Refurbishment Work for Existing Main Dewatering Pumps (MDP-1 and MDP-2) Pump Well #3." Refer to Attachment "B" for the "Operation and Maintenance Manual, Existing Main Dewatering Pumps (MDP-1 and MDP-2) Pump Well #3."

1.2 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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 1068 (2009) Petroleum & Chemical Industry Motor Repair

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

Qualifications - Pump and Motor Overhaul and Refurbishment; G

SD-02 Shop Drawings

Overhaul and Refurbishment Procedures - Pumps and Motors; G

SD-03 Product Data

Overhaul and Refurbishment Materials and Equipment; G

SD-06 Test Reports

Shop Pump and Motor Tests; G

Field Pump and Motor Tests; G

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage or in transport from the weather, humidity and temperature variations, dirt and dust, or other

contaminants.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Submit qualifications of overhaul and refurbishment subcontractors indicating their experience in the work required by this section. Separate subcontractors for pumps and motors are anticipated. Submit data for approval showing that the Contractors have successfully overhauled pumps, pump motors, and associated equipment and components of the same size, capacity, type and design as required by this section, or that he/she has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has overhauled such motor and pump systems. Indicate the type of each motor and pump system and certify that each motor and pump has performed satisfactorily in the manner intended for a period of not less than 18 months.

PART 2 PRODUCTS

2.1 OVERHAUL AND REFURBISHMENT MATERIALS AND EQUIPMENT

Refer to Attachment "A" for the "Scope of Overhaul and Refurbishment Work for Existing Main Dewatering Pumps (MDP-1 and MDP-2) Pump Well #3."

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the overhaul and refurbishment of vertical turbine pumps, motors, and components.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field and advise the Contracting Officer of any discrepancies before performing the overhaul and refurbishment work.

3.2 COORDINATION

The work of this section shall be coordinated with the sequencing notes on Sheet G-003 and with the Contracting Officer.

3.3 OVERHAUL AND REFURBISHMENT PROCEDURES AND REQUIREMENTS

Refer to Appendix "A" for the "Scope of Overhaul and Refurbishment Work for Existing Main Dewatering Pumps (MDP-1 and MDP-2)" located in Pump Well #3. Provide work outlined in accordance with references listed in paragraph entitled "Overhaul and Refurbishment References" herein.

3.4 RIGGING

Provide rigging for removal of equipment from pump well and reinstallation after shop overhaul and refurbishment work.

3.5 TESTING

3.5.1 Shop Pump and Motor Tests

After completion of overhaul, test pumps and motors for satisfactory operation as follows:

- a. Running test.
- b. Witnessed running test in presence of Government Representatives.
- c. Motor windings shop tests per IEEE Std 1068.
- d. Motor running amps.
- e. Motor speed.
- f. Motor vibration.

3.5.2 Field Pump and Motor Tests

After re-assembly and installation of the overhauled and refurbished pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. Provide an accurate and acceptable method of measuring the discharge flow, total head and vibration. This testing will require flooding of the dry dock and, therefore, shall be coordinated with a scheduled docking evolution. Provide electric test equipment to monitor motor operation during tests. Record starting amperage, no load running amps, full load running amps, no load power factor, full load power factor, no load voltage at starter, and full load voltage at starter.

3.5.2.1 Correct Installation of Appurtenances

Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

3.5.2.2 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted at no additional cost to the Government.

3.5.3 Test Reporting

Submit test reports in booklet form documenting shop tests, field tests and showing field tests performed to adjust each component and field tests performed.

-- End of Section --

