ADDENDUM #4

For
NASA DFRC EDM-1703

Facilities Support Center

At

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SECTION 01 33 29

LEED(TM) DOCUMENTATION
02/10

PART 1 GENERAL

1.1 REFERENCES

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

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2000; R2008) Principles and Criteria for Forest Stewardship

GREEN SEAL (GS)

GC-03	(1997) Anti-Corrosive Paints
GS-11	(1993) Paints
GS-36	(2000) Commercial Adhesives

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications
SCAQMD Rule 1113	Architectural Coatings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)
LEED Reference Guide	(2009) LEED Reference Guide for Green Building Design and Construction

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

LEED Implementation Plan; G (LEED)

SD-11 Closeout Submittals

LEED Documentation Notebook; G (LEED)

1.3 DESCRIPTION

This project has been designed for, and shall be developed for a sustainable rating of Platinum in accordance with LEED 2009 Version 3.0. Table 1 (see paragraph Table) identifies the LEED credit items that are designed into or otherwise required for this project. No variations or substitutions to the LEED credits identified for this contract shall be allowed without written consent from the Contracting Officer. Should there be a case where there is any problem meeting the full requirements of a LEED credit identified for this project in Table 1, the Contractor must bring this to the attention of the Contracting Officer immediately.

1.3.1 Credit Validation

This project will be registered with USGBC for validation of credits earned. Contractor is not responsible for registering the project with USGBC or for paying project registration fees to USGBC. Format and content of all construction documentation must be in accordance with the LEED Reference Guide requirements for supporting data required in event of USGBC audit of the particular credit. Contractor is required to coordinate through the Contracting Officer with Government's LEED consultant on assuring assembled data is acceptable to USGBC and responding to USGBC requests for additional construction data in the course of seeking project certification. Credit documentation will be tracked and submitted using the LEED Letter Template forms.

1.3.2 Contractor Responsibilities

Some LEED credits are inherent in the design provided and require no further submittal or documentation. For these credits, the Contractor shall notify the Contracting Officer in advance of selection of any specified material or use of any permissible construction methods that may result in a deviation from the LEED designer intent. Some LEED credits involve material selection and are generally identified within the technical sections with the notation "LEED," though not specifically identified in all occurrences. Some LEED credits are dependent on construction practices.

All LEED credits identified in Table 1 not inherent in the design provided shall be documented by the Contractor. Table 1 provides a general summary of applicable credits. Detailed submittal requirements are contained in the LEED Reference Guide and in the technical sections.

In all cases where a material, product, or execution requirement is identified by "LEED" in the contract documents, additional data or certificates shall be submitted with the individual component or process validating the material or component to the respective LEED credit item. These additional data or certificates shall be separable from the other submitted data and a copy shall be included in the LEED Documentation Notebook in addition to the distribution indicated in the submittal register.

1.4 LEED IMPLEMENTATION PLAN

LEED Implementation Plan shall be submitted within 30 days after notice to proceed and prior to the start of the construction submittal and review process. The plan, when completed, shall provide a detailed description of all activities that relate to accomplishing project LEED requirements, including construction practices, procurement practices, and proposed submittals and documentation for each LEED credit. Plan shall also include

the following:

a. Name of individual on the Contractor's staff responsible for ensuring LEED credits and prerequisites are earned and responsible for assembling documentation. A responsible individual shall be identified for each applicable credit. This individual may fill the role of QC Administrative Assistant specified in Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL.

b. Templates to be used for tracking LEED credits. Listing of documents to be provided for each credit and schedule for their inclusion in LEED Documentation Notebook. Include proposed materials, associated estimated costs, and details necessary for LEED calculations in order to determine if the listed materials can be expected to achieve the project goal.

c. List of all plans required in the technical sections for LEED credit. Proposed submittal date for each plan. These shall be added to the LEED Implementation Plan as they are completed.

d. Implementation plan for cumulative materials credits, which shall use applicable template with proposed materials, associated estimated costs, and details necessary for LEED Calculations added in order to determine if the listed materials can be expected to achieve the project goal. Submit cumulative materials implementation plans as part of the submittal procedure and before materials purchasing begins.

1.5 LEED DOCUMENTATION NOTEBOOK

The Contractor shall prepare a comprehensive notebook documenting compliance for each LEED credit identified in Table 1. LEED Documentation Notebook shall be formatted to match LEED numbering system and tabbed for each credit and prerequisite. LEED documentation in notebook shall contain up to date information through the previous week's work, and at least one set shall be available on the jobsite at all times. The Notebook shall also be maintained and available for reference electronically if preferred. Completed pages shall be prevented from being altered. If the Contractor fails to maintain the LEED Documentation Notebook as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the Notebook. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of the Notebook. The original, one copy, and an electronic version on CD of the notebook shall be submitted at project closeout.

1.5.1 Content

Notebook shall include Table 1, applicable product data for material selection, final calculations, certifications for construction practices, procurement data, cumulative calculations and other items as identified in the approved LEED Implementation Plan. Notebook must contain all required data to support full compliance with the indicated LEED credit. LEED credits that are inherent to the design will be documented by the designer of record.

1.5.2 LEED Calculations

Calculations showing compliance with a required LEED credit identified in

Table 1 or within the LEED Implementation Plan. Calculations shall be current and available for monthly review. Final calculations shall be included in the LEED Documentation Notebook under the appropriate tab.

1.5.3 Submittals

All "G" designated submittals required for inclusion in the LEED Documentation Notebook shall be separable from other submitted data and shall be included in the LEED Documentation Notebook in addition to the distribution indicated on the submittal register.

1.6 REQUIREMENTS

LEED credits as identified in Table 1 shall be incorporated and documented as required by the Contract documents and in full compliance with the LEED Reference Guide. LEED credits not identified elsewhere in the Contract documents and those requiring further instruction are specified below. Refer to the LEED Reference Guide for further definitions and requirements.

1.6.1 Materials and Resources Credit 4, Recycled Content

Not withstanding the requirements of Section 01 62 35 RECYCLED/RECOVERED MATERIALS, Contractor shall select materials so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least 30 percent of the total materials cost for the project. EPA Comprehensive Procurement Guidelines has a supplier database. California Integrated Waste Management Board (CIWMB) Recycled Content Directory also contains product and supplier data at www.ciwmb.ca.gov/rcp.

1.6.1.1 Calculations

LEED Letter Template forms shall be used for tracking and documentation. Recycled content value of project materials shall be determined by the method described in the LEED Reference Guide.

1.6.1.2 Indoor Environmental Quality Credit 4, Low-Emitting Materials

Contractor shall select low-emitting materials for use on the interior of the building that comply with SCAQMD Rule 1168, SCAQMD Rule 1113, GS-11, GS-36, GC-03, requirements of the Carpet and Rug Institute Green Label and Green Label Plus programs, and the FloorScore Standard, whenever applicable, in accordance with the LEED Reference Guide.

1.6.1.3 Calculations

LEED Letter Template forms shall be used for tracking and documentation.

1.6.1.4 Substitutions

In the case of conflict between this requirement and individual technical section requirements, Contractor may submit for Government approval proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. All such proposed substitutions shall be submitted with the LEED Implementation Plan accompanied by product data that demonstrates equivalence.

1.6.2 Materials and Resources Credit 5, Regional Materials

Contractor shall select materials so that a minimum of 20 percent (by dollar value) of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site.

1.6.2.1 Calculations

LEED Letter Template forms shall be used for tracking and documentation. Amount of regional project materials shall be determined by the method described in the LEED Reference Guide.

1.6.3 Materials and Resources Credit 6, Rapidly Renewable Materials

A minimum of 2.5 percent (by dollar value) of materials and products for the project shall be rapidly renewable. Rapidly renewable materials are made from plants with a 10-year or shorter harvest cycle. The following rapidly renewable materials are specified: cotton, linseed (linoluem), biocomposites and rubber. Contractor shall track cumulative calculations for this credit.

1.6.4 Materials and Resources Credit 7, Certified Wood

Contractor shall select materials so that a minimum of 50 percent (by dollar value) of permanently installed wood-based materials and products for the project are certified in accordance with FSC STD 01 001.

1.6.4.1 Calculations

LEED Letter Template forms shall be used for tracking and documentation. Amount of FSC-certified project materials shall be determined by the method described in the LEED Reference Guide.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 COORDINATION MEETINGS

There will be three onsite coordination meetings. The first will be a preconstruction meeting to review the LEED Implementation Plan. The requirements for this meeting may be fulfilled 01 45 04.00 10 CONTRACTOR QUALITY CONTROL. The second will be a pre-closeout meeting to review LEED Documentation Notebook for completeness and identify any outstanding issues relating to final score and documentation requirements. The third is a closeout meeting to review the final LEED Documentation Notebook. All meetings shall be attended by Contractor's designated individual responsible for LEED documentation, Government representative and Installation representative. At closeout meeting a final score for the project will be determined based on review of project performance and documentation. Contractor shall make a set of contract drawings and specifications available for review at each meeting as well as an updated LEED Documentation Notebook.

3.2 TABLE

LEED credits as identified in Table 1 below are contract requirements and shall be incorporated in full compliance with the LEED Reference Guide.

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E 1609	(2001) Development and Implementation of a Pollution Prevention Program

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 95 percent by weight of total project solid waste shall be diverted from the landfill in support of EO 13423, Section 2 and NASA Procedural Requirements (NPR) 8530.1 and in accordance with the LEED Reference Guide.

1.3 MANAGEMENT

Develop and implement a waste management program in accordance with ASTM E 1609 and the LEED Reference Guide. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The QC Manager, as specified in Section 01 45 00.10 40 CONTRACT QUALITY CONTROL, shall be responsible for managing and coordinating with the workers implementing the Waste Management Plan for the project, and shall be responsible for documenting the results of the Waste Management Plan, in accordance with the LEED Reference Guide. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar

incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

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

SD-01 Preconstruction Submittals

Waste Management Plan; G (LEED)

SD-11 Closeout Submittals (LEED)

Records

Salvage Material Records shall be submitted in accordance with Paragraph "SALVAGE MATERIALS AND EQUIPMENT"

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 14 days after notice to proceed. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and using the LEED Letter Template. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be included in the LEED Documentation Notebook.

1.7 SALVAGE MATERIALS AND EQUIPMENT

All metals and items of historic value shall be salvaged and shall remain the property of the Government. Salvage Material Records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction. The contractor shall coordinate with the local waste removal agency to identify remaining recyclable materials. Salvage items shall be marked, segregated, itemized, delivered, and off-loaded by the Contractor at the storage area near Building 4876.

The Contractor shall maintain adequate property control records for all

materials or equipment designated as salvage. These records may be in accordance with the Contractor's system of property control, if approved by the Contracting Officer. The Contractor shall be responsible for adequate storage and protection of salvaged materials and equipment and shall replace, at no cost to the Government, salvage materials.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 35 14.11 40 DRYDEN SAFETY REQUIREMENTS.

Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

   (1) Ferrous.

   (2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall

be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incenerator. Limit amount of waste disposed at a landfill to no more than 5 percent by weight of the total project waste, in accordance with the LEED credit requirements.

1.9.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE
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.

ACI INTERNATIONAL (ACI)

ACI/MCP-1	(2009) Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	(2009) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2009) Manual of Concrete Practice Part 3 - ACI 315-99 to ACI 343R-95
ACI/MCP-4	(2009) Manual of Concrete Practice Part 4 - ACI 345R-05 to 355.2R-04

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2009) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 143/C 143M	(2008) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2007) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 567	(2005a) Determining Density of Structural Lightweight Concrete

ASTM C 595	(2008a) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 2103	(2008) Standard Specification for Polyethylene Film and Sheeting
ASTM D 4397	(2009) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses

ASTM E 329	(2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2009a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2000) Principles and Criteria for Forest Stewardship

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2007) Construction and Industrial Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS MMM-A-001993	(1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)
FS SS-S-1614	(Rev A; Am 1) Sealants, Joint,Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements
FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Reinforcing steel; G
Locations of the concrete slab construction joints, expansion joints and contraction joints; G

Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Materials for curing concrete
Joint sealants; (LEED)

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Joint filler; (LEED)
Plastic Forms
Carton Forms
Aggregate; G
Recycled Aggregate Materials; G (LEED)
Cement; G (LEED)
Portland Cement; G
Ready-Mix Concrete; G
Water-Vapor Barrier Subgrade Cover
Bonding Materials
Floor Finish Materials
Concrete Curing Materials
Reinforcement; G (LEED)
Reinforcement Materials
Liquid Chemical Floor Hardener

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

value of products included in project.

Vapor retarderVapor barrier
Epoxy bonding compound
Waterstops
Wood Forms
Local/Regional Materials; G (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-04 Samples

Slab finish sample

Submit the following samples:

Three samples of each type waterstop, 1/2 inch long.

Dumbbell Type
Rubber
Polyvinylchloride (PVC)

SD-05 Design Data

Concrete mix design; G

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. Each concrete mix design shall be developed under the direct supervision of a California Registered Civil Engineer.If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, and pozzolan test results, in addition. The approval of fly ash, and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design; G
Fly ash; G
Pozzolan
Ground granulated blast-furnace slag; G
Compressive strength tests; G
Unit weight of structural lightweight concrete
Slump; G

SD-07 Certificates

Curing concrete elements
Pumping concrete
Biodegradable Form Release Agent
VOC Content for form release agents, curing compounds, and concrete penetrating sealers
Material Safety Data Sheets
Forest Stewardship Council (FSC) Certification

SD-08 Manufacturer's Instructions

Fly ash; G
Ground granulated blast-furnace slag

Welding Procedures must be in accordance with AWS D1.4/D1.4M.

Submit mill certificates for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Provide certificates for Welder Qualifications that are in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Welding Procedures

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be

accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.2 Drawings

1.6.2.1 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.3 Control Submittals

1.6.3.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.4 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.

1.6.4 Test Reports

1.6.4.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.6.4.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.6.4.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.6.5 Field Samples

1.6.5.1 Slab Finish Sample

Install minimum of 10 foot by 10 foot slab. Finish as required by specification.

1.6.6 Special Finisher Qualifications

For 35 percent or more fly ash content as a percentage of cementitious materials, finisher must have a minimum of 3 years' experience finishing high-volume fly ash concrete.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing compound/sealer curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

Include the following in the LEED Documentation Notebook, and in accordance with the LEED Reference Guide credit requirements.

a. Provide data of the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.

b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate by weight.

c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.

d. Provide product data stating the location where all products were harvested, extracted or recovered, as well as manufactured.

e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products. See Section 01 33 29 LEED DOCUMENTATION for cumulative total FSC certified material requirements.

f. For projects using reusable formwork, provide data showing how formwork is reused.

g. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

h. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED DOCUMENTATION for cumulative total local/regional material requirements.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers, and include in LEED Documentation Notebook..

1.8.3 Materials Containing Recycled Content

Use materials or products containing post-consumer and/or post-industrial recycled content wherever possible, in accordance with the LEED Reference Guide. See Section 01 33 29 LEED DOCUMENTATION for cumulative total requirements for materials containing recycled content.

1.9 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

1.10 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Use lumber as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins. Virgin wood used must be FSC-certified.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the

manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.2 Lightweight Concrete Proportion

ACI/MCP-1, using weight method. Provide ASTM C 330 aggregates for concrete; 115 pcf (dry) for floors with a 3500 psi minimum compressive strength at 28 days. Maximum water-cement ratio must be 0.50.

2.3.1.3 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work. Curing componds shall only be used with specific approval of the contracting officer.

2.4 MATERIALS

2.4.1 Cement

ASTM C 150, Type II or ASTM C 595, Type IP(MS) or IS(MS) blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type F, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C 311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

1. For GGBF slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C 989, Grade 80. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Portland Cement

Provide cement that conforms to ASTM C 150, Type II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement + pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33/C 33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.4.3.1 Aggregates for Lightweight Concrete

ASTM C 330.

2.4.3.2 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered concrete recovered porcelain recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

2.4.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.4.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C 260.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and Type G (HRWR retarding admixture) and ASTM C 1017/C 1017M.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum 10 mil thickness.

2.4.6.1 Water-Vapor Barrier Subgrade Cover

Provide cover that clear polyethylene sheeting, 10-mil, conforming to ASTM D 2103 and ASTM D 4397

2.4.7 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds) VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.8 Liquid Chemical Sealer-Hardener Compound

Provide magnesium fluorosilicate compound which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Provide compound that does not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.9 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100% post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.9.1 Preformed Joint Filler Strips

Povide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.10 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T.

2.4.10.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T. FS SS-S-1614.

2.4.10.3 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

Provide waterstops made of polyvinylchloride (PVC) and that conform to ASTM C 990.

2.4.10.4 Joint Sealant Compound

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.11 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.12 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and grapeseed oil-based soy oil-based or water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A 615/A 615M with the bars marked A, S, W, Grade 60; ASTM A 706/A 706M. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Reinforcing bars may contain post-consumer or post-industrial recycled content.

2.5.1.1 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A 706/A 706M and ASTM A 615/A 615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI/MCP-2. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

2.5.3.1 Steel Wire

Wire must conform to ASTM A 82/A 82M.

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material. Use engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.

2.5.5 Chairs and Bolsters: Plastic or Steel

See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content.

2.5.6 Dowels for Load Transfer in Floors

Provide dowels for load transfer in floors of the type, design, weight, and dimensions indicated.

2.5.7 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

2.7 FLOOR FINISH MATERIALS

2.7.1 Liquid Chemical Floor Hardener

Hardener must be a colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent. Solution must contain not less than 1/2 pounds of fluorosilicates per

gallon. An approved proprietary chemical hardener may be used provided hardener is delivered ready for use in manufacturer's original containers.

2.7.2 Abrasive Aggregate for Nonslip Aggregate Finish

Aggregate must be packaged, factory-graded fused aluminum oxide grits, or it may be crushed emery containing not less than 40-percent aluminum oxide and not less than 25-percent ferric oxide. Aggregate must be rust proof and nonglazing and must be unaffected by freezing, moisture, and cleaning materials.

Aggregate must be well-graded in size from particles retained on No. 30 sieve (0.0236 inch) to particles passing No. 8 sieve (0.0929 inch).

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Drainage fill	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of drainage fill under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Cover drainage fill surface under interior slabs on ground with specified water-vapor barrier subgrade cover immediately prior to placing reinforcement. Install subgrade cover to avoid puncture or tear. Patch punctures or tears over 12 inches with separate sheets lapped not less than 6 inches. Seal all punctures or tears less than 12 inches with pressure-sensitive vapor barrier tape not less than 2-inches wide. Seal lapped joints with vapor barrier adhesive or pressure-sensitive vapor barrier tape not less than 2-inches wide. Lay subgrade cover sheets with not less than a 6-inch lap at edges and ends and in direction in which concrete is to be placed.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless

otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to and ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a, nonstaining 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.

3.3.4 Reshoring

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, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads,

eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.9 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.10 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.10.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 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. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with, and ACI/MCP-4 and as specified.

3.6.2 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material. Place a 2 inch layer of clean concrete sand on vapor barrier before placing concrete.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M. Approve welded splices prior to use.

3.6.5 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Calk the depression after the bolt is installed.

3.6.6 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.7 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.8 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated. Locations of construction joint shall be approved by the Contracting Officer.

3.6.9 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. Fill expansion joints not exposed to weather with preformed joint filler material. 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. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter. Locations of the expansion and contraction joints shall be approved by the Contracting Officer.

3.6.10 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with and ACI/MCP-3.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.11 Placing Reinforcement

Place reinforcement in accordance with ACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the Contracting Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP-4 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, tied to main steel approximately 24 inches on center, reinforcement must be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI/MCP-3.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified inand ACI/MCP-4.

3.6.12 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with theACI/MCP-3.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.13 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-4, ASTM E 648,and ACI/MCP-3.

3.6.14 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Mixing

ASTM C 94/C 94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.2 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

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. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.5.1 Pumping Lightweight Concrete

ACI/MCP-1. Presoak or presaturate aggregates. Cement content must be minimum of 564 pounds per cubic yard and be sufficient to accommodate a 4 to 6 inch slump.

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment

supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated

and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink 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 must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

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

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile, ceramic tile, are indicated. Steel trowel and fine-broom finish. concrete slabs that are to receive quarry tile, ceramic tile, or paver tile Where straightedge measurements are specified, Contractor must provide

straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Floated

Use for surfaces to receive roofing, waterproofing membranes, sand bed terrazzo, and 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 must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings. First, provide a floated finish. Next, the finish must be power troweled two three times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Apply dry shake aggregate of ceramically bonded aluminum oxide to the surface at a minimum rate of 25 pounds per 100 square feet. Blend approximately two-thirds of the aggregate with portland cement as recommended by the manufacturer and apply to the surface evenly and without segregation. After blended material has been embedded by floating, apply the remainder of the blended material to the surface at right angles to the previous application. Apply blended material heavier in any areas not sufficiently covered by the first application. Perform a

second floating immediately following the first. After the selected material has been embedded by the two floatings, complete the operation with a finish, as indicated in drawings.

3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. 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.

3.10.1.6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained or a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.7 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are either freshly placed and still plastic, or on hardened base slabs.

a. Placing on a Fresh Base: Screed and bull float the base slab. As soon as the water sheen has disappeared, lightly rake the surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread the topping mixture evenly over the roughened base before final set takes place. Give the topping the finish indicated on the drawings.
b. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying, grit-blasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 41 degrees F at the time of placing. Place the topping and finish as indicated.

3.10.1.8 Chemical-Hardener Treatment

Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

3.10.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.4 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.5 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Where the use of a curing compound is allowed by the contracting officer, do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 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.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 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.

3.11.3 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 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. 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 must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 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.

3.11.4 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. Do not apply the sealer hardener until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.11.5 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.6 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms

are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.7 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.8 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.9 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.10 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders

are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C 173/C 173M or ASTM C 231 for normal weight concrete and ASTM C 173/C 173M for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Unit Weight of Structural Lightweight Concrete

ASTM C 567. Determine unit weight of lightweight concrete. Perform test for every 20 cubic yards maximum.

3.12.2.6 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of

temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C 42/C 42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate on-site area to be paved later in project for cleaning out concrete mixing trucks.

3.13.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement.

3.13.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily

secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

Sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and control joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.17 CONCRETE FLOOR TOPPING

3.17.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

Materials

Provide materials that conform to requirements specified, except aggregate must be as follows:

TYPE OF AGGREGATE	SIEVE	PERCENT PASSING
Fine aggregate	3/8 inch	100
	No. 4	95 to 100
	No. 8	80 to 90
	No. 16	50 to 75
	No. 30	30 to 50
	No. 50	10 to 20
	No. 100	2 to 5
Coarse aggregate	1/2 inch	100
	3/8 inch	95 to 100
	No. 4	40 to 60
	No. 8	0 to 5

Standard Topping Mixture

Provide mixture that consists of one part portland cement, one part fine aggregate, and two parts coarse aggregate, by volume. Adjust exact proportions of fine and coarse aggregates to produce a well-graded total aggregate. Mixing water must not exceed 5 gallons per 94-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 2 inches.

Preparations Prior to Placing

When mixture is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface

of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping mixture as specified.

When mixture is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, (2-1/2-inches minimum) slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping mixture is placed.

When mixture is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface. Immediately before topping mixture is placed, spray or brush a coating of concrete bonding agent onto metal surfaces and do not be allow to set or dry before topping mixture is applied.

Mixing

Do the mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a suitable charging hopper, water storage tank, and water-measuring device and must be capable of mixing aggregates, cement, and water into a uniform mix within specified mixing time and of discharging mix without segregation. Provide mixer that bear a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes. Increase mixing time 15 seconds for each additional cubic yard or fraction thereof.

Clean mixer, and replace blades in drum when they have lost 10 percent of their original depth.

Truck-mixed topping may be used when approved. Specify truck-mixed topping for ready-mix concrete.

Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated. Specify such finishes for required finish.

3.17.2 Heavy-Duty Floor Topping

Provide topping where indicated.

Heavy-duty Topping Mixture

Provide mixture that consists of 1 part portland cement and 2-1/2 parts emery aggregate or 1 part fine aggregate and 1-1/2 parts traprock coarse aggregate, by volume. Exact proportions of mixture must conform to recommendations of aggregate manufacturer. Mixing water must not exceed 3-1/4 gallons per 95-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 1 inch.

Base Slab

Screed surface of slab to a level no more than 1-1/2 inches nor less than 1 inch below grade of finished floor.

Give slab a scratch finish as specified.

Preparations prior to placing

Remove dirt, loose material, oil, grease, asphalt, paint and other contaminants from base slab surface. Prior to placing topping mixture, dampen slab surface and leave free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Allow cement grout to set or dry before topping mixture is placed.

Mixing

Do mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a charging hopper, water storage tank, and a water-measuring device and the batch mixer must be capable of mixing aggregates, cement, and water into a uniform mix within the specified mixing time and of discharging mix without segregation. Provide mixer that bears a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes.

Increase mixing time 15 seconds for each additional cubic yard or fraction thereof. Clean mixer, and replace pick-up and throw-over blades in drum when they have lost 10 percent of their original depth.

Placing

Spread heavy-duty topping mixture evenly on previously prepared base slab, and bring to correct level with a straightedge, and strike off. Provide topping that is consolidated, floated, and checked for trueness of surface as specified for float finish, except that power-driven floats is the impact type.

Finishing

Give trowel finish heavy-duty floor topping surfaces. Provide trowel finish as specified, except that additional troweling after first power troweling must be not less than three hand-troweling operations.

-- End of Section --

SECTION 04 20 00

MASONRY
02/09

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.

ACI INTERNATIONAL (ACI)

ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary
ACI 530/530.1	(2008; Errata 2008; Errata 2009) Building Code Requirements and Specification for Masonry Structures; Containing Building Code Requirements for Masonry Structures, Specification for Masonry Structures and Companion Commentaries
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B 370	(2009) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C 1019	(2009) Standard Test Method for Sampling and Testing Grout
ASTM C 1072	(2006) Standard Test Method for

	Measurement of Masonry Flexural Bond Strength
ASTM C 1142	(1995; R 2007) Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C 129	(2006) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 270	(2008a) Standard Specification for Mortar for Unit Masonry
ASTM C 476	(2009) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 593	(2006) Fly Ash and Other Pozzolans for Use with Lime
ASTM C 641	(2009) Staining Materials in Lightweight Concrete Aggregates
ASTM C 744	(2009) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2009) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2009) Loadbearing Concrete Masonry Units
ASTM C 94/C 94M	(2009a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM E 514/E 514M	(2009) Water Penetration and Leakage Through Masonry

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007) Seismic Design for Buildings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

1.2.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site.

1.2.2 Design Requirements

1.2.2.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.2.2.2 Seismic Requirement

In addition to design requirements of ICC IBC, provide additional seismic reinforcement as detailed on the drawings. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

Wall Type	Vertical	Horizontal
Structural	24 inches	48 inches
Non-structural	48 inches	80 inches

Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.

1.2.2.3 Special Inspection

Perform special inspections and testing for seismic-resisting systems and components in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS.

1.2.2.4 Masonry Strength

Determine masonry strength in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.2.3 Additional Requirements

a. Maintain at least one spare vibrator on site at all times.

b. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

1.2.4 ENVIRONMENTAL DATA

The following shall be submitted in accordance with LEED:

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Indicate type and amount of rapidly renewable material in product. Indicate relative dollar value of rapidly renewable content products to total dollar value of products included in project. Documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook. Indicate distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

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

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

SD-03 Product Data

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site, and distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in the project.

Concrete Masonry Units (CMU); G (LEED)
Cement; G (LEED)
Insulation

Flashing
Water-Repellant Admixture

Manufacturer's descriptive data. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Cold Weather Installation

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU); G

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

Anchors, Ties, and Bar Positioners

Two of each type used.

Expansion-Joint Materials

One piece of each type used.

Insulation

One piece of board type insulation, not less than 16 by 24 inches in size, containing the label indicating the rated permeance and R-values.

SD-05 Design Data

Pre-mixed Mortar; G
Unit Strength Method; G

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Field Testing of Mortar; G
Field Testing of Grout; G

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.

Masonry Inspector Qualifications; G

Copies of masonry inspector reports.

SD-07 Certificates

Concrete Masonry Units (CMU)
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Reinforcing Steel Bars and Rods
Mortar Coloring
Insulation
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-10 Operation and Maintenance Data

Take-Back Program

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.

SD-11 Closeout Submittals

Environmental Data; G (LEED)

Provide documentation relative to recyled content, local/regional materials, low-emitting materials, and rapidly renewable materials credit for Concrete Masonry Units (CMU), cement, mortar, grout, admixtures, aggregates, and sealants. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

1.4.1 Sample Masonry Panels

After material samples are approved and prior to starting masonry work, construct a sample masonry panel for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, submit written notification to the Contracting Officer. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.4.1.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4 feet high.

1.4.1.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of

reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, flashing, shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.4.1.3 Construction Method

Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.4.1.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4.2 Masonry Inspector Qualifications

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.4.3 Detail Drawings

Submit detail drawings showing bar splice locations. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop

drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

1.5 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.

1.5.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C 90. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.5.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.5.3 Cementitious Materials, Sand and Aggregates

"Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume. 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. Cementitious material such as fly ash, can consist of post-industrial recycled content and can be used in grout and concrete. See Section 01 33 29 LEED DOCUMENTATION for cumulative total recycled content requirements. Recycled content value of cementitious materials can be based on the mass of the cementitious materials only, in accordance with the LEED Reference Guide.

1.6 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.6.1 Hot Weather Installation

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

1.6.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, submit a written statement of proposed cold weather construction procedures for approval.

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.

2.2 CONCRETE MASONRY UNITS (CMU)

Submit samples and documentation as specified. Cement shall have a low alkali content and be of one brand. Units shall contain a minimum of 18 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Units may contain post-consumer or post-industrial recycled content. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond; exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

a. Hollow Load-Bearing Units: ASTM C 90, made with lightweight or medium weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C 129, made with lightweight or medium weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.

2.2.1 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 C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification. In lieu of virgin aggregates, use a minimum of 18 percent industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and/or expanded slag in aggregates. Slag shall comply with ASTM C 989.

2.2.2 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 except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.3 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.3.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. In reinforced masonry, lintels shall conform to ACI 318 for flexural and shear strength and shall have at least 8 inches bearing at each end. Concrete shall have a minimum 28 day compressive strength of 4000 psi using 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement shall conform to ASTM A 615/A 615M Grade 60,000 psi. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches. Provide top and bottom bars for lintels over 36 inches in length.

2.3.2 Sills and Copings

Sills and copings shall be cast with washes. Sills for windows having mullions shall be cast in sections with head joints at mullions and a 1/4 inch allowance for mortar joints. The ends of sills, except a 3/4 inch wide margin at exposed surfaces, shall be roughened for bond. Treads of door sills shall have rounded nosings. Reinforce sills with not less than two No. 4 bars.

2.3.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.4 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type II portland cement. Use Type IS blended hydraulic cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in

cement-lime mortar and 18 percent in masonry cement mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C 593.

2.5 MASONRY MORTAR

Mortar Type S shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.5.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.5.2 Colored Mortar

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching the exposed CMU units. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall equal 180 psi.

2.5.3 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S.

2.5.4 Cement

Portland cement shall conform to ASTM C 150/C 150M, Type II. 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. Additives shall conform to requirements in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.5.5 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RS.

2.5.6 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.6 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with

ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514/E 514M, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.7 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, coarse. 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 C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.7.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.2A Grout Aid Admixture such as SIKA Grout Aid shall be used in accordance with the manufacturer's recommendations.

2.7.2 Grout Barriers

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

2.8 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82/A 82M. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.8.1 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.8.2 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.9 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.10 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.11 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS, and shall be penetrating with a maximum volatile organic compound (VOC) content in accordance with the low-emitting materials requirements in the LEED Reference Guide.

2.12 THROUGH WALL FLASHING

Flashing shall be as specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide one of the following types

a. Coated-Copper Flashing: 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces/square foot (approximately 3 ounces/square foot on each side).

b. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

2.13 WEEP HOLE VENTILATORS

Weep hole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

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 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of

heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 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 from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be

slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 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. Open end units shall be used. 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. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.

c. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. The vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Fill all cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. 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. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units shall be full bedded in mortar under both face shells and webs. Head joints shall be filled solidly with mortar walls grade shall be grouted solid. 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, gable slopes, and elsewhere as approved.

Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	

TOLERANCES

Minus	1/4 inch
Plus	1/2 inch

3.2.5 Cutting and Fitting

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

3.2.6 Jointing

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

3.2.6.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.6.2 Tooled Joints

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

3.2.6.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.7 Joint Widths

Joint widths shall be as follows:

3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.8 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.9 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.10 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck, unless shown otherwise. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown.

3.3 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated on drawings. Weep holes shall be clear round holes not less than 1/4 inch in diameter at 24 inches o.c. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.4 MORTAR MIX

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2.5 hours after mixing shall be discarded.

3.5 REINFORCING STEEL

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

3.5.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.5.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement and as indicated on drawings. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.6 PLACING GROUT

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

3.6.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.6.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.6.3 Grout Holes and Cleanouts

3.6.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.6.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.6.4 Grouting Equipment

3.6.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.6.4.2 Vibrators

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

3.6.5 Grout Placement

Masonry shall be laid 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, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.6.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and

settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.6.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension 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) For grouting spaces between masonry wythes.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.8 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using mortar to fill the head joint in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.9 JOINTS SHOWN ON THE DRAWINGS

a. will be located, detailed, and constructed as shown on the drawings. Keep joints free of mortar and other debris.

3.10 SHELF ANGLES

Adjust shelf angles as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized and provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.11 LINTELS

3.11.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement

shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.11.2 Precast Concrete and Steel Lintels

Construct precast concrete and steel lintels as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.12 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.13 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.13.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.14 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 1/2 inch thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 6 inches below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.15 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.16 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.

3.16.1 Dry-Brushing

a. Exposed concrete masonry unit

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

3.17 BEARING PLATES

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.18 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.19 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. See Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.19.1 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. Separate selected masonry waste and excess for landscape uses, either whole or crushed as ground cover.

3.19.2 Take-Back Program

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap and packaging 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.

3.20 TEST REPORTS

3.20.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.20.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout

per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

3.20.3 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms will be used in each sample. Prisms shall be tested in accordance with ACI 530/530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall not be less than 1500 psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
10/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201-06	(2006) AISC Certification Program for Structural Steel Fabricators
AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 317	(1992; Reprint 1999) ASD Manual of Steel Construction, Vol II: Connections
AISC 325	(2005) Manual of Steel Construction
AISC 326	(2009) Detailing for Steel Construction
AISC 341	(2005; Supp 2005) Seismic Provisions for Structural Steel Buildings
AISC 348	(2000) Structural Joints Using ASTM A325 or A490 Bolts
AISC 350	(2005) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary
AISC 810	(1997) Erection Bracing of Low-Rise Structural Steel Frames/Fisher and West

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2002) Surface Texture (Surface Roughness, Waviness and Lay)

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143/A 143M	(2007) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2009a) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 490	(2009) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 500/A 500M	(2009) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2005; R 2009) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 6/A 6M	(2009) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 780/A 780M	(2001; R 2006) Standard Practice for

	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 827	(2001a; R 2005) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F 436	(2009) Hardened Steel Washers
ASTM F 844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2007a) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; E 2004) Epoxy-Polyamide Painting System
SSPC Paint 25	(1997; E 2004) Paint Specification No. 25 Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II
SSPC SP 3	(2004; E 2004) Power Tool Cleaning
SSPC SP 6	(2007) Commercial Blast Cleaning

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 325 and AISC 317 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

Conform to , AISC 317, AISC 360, AISC 303, AISC 348, and AISC 325, except as modified in this section.

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

Erection Plan, including description of temporary supports; G
Fabrication drawings including description of connections; G

SD-03 Product Data

Shop primer
Welding electrodes and rods
Load indicator washers
Non-Shrink Grout
Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating
Bolts, nuts, and washers

Supply 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.

SD-07 Certificates

Steel
Bolts, nuts, and washers
Galvanizing
AISC Quality Certification
Welding procedures and qualifications

SD-11 Closeout Submittals

Steel (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Shop Primer (LEED)

LEED documentation relative to low-emitting materials in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Sbd fabrication plant.

1.6 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with AISC 341.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 325 and AISC 317. Fabrication drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.7.2 Certifications

1.7.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.7.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

1.8 Environmental Data

Steel is recognized as consistently containing recycled content. Many steel products contain 90 percent or higher recycled content if manufactured by the electric arc furnace process. Submit documentation indicating the percentage of post-industrial and/or post-consumer recycled content per unit of product. Indicate relative dollar value of products included in project. See Section 01 33 29 LEED DOCUMENTATION for cumulative total recycled content requirements.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A 992/A 992M 50.

2.1.2.2 Quenched and Tempered Alloy Steel

ASTM A 514/A 514M.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

2.1.4 Structural Steel Tubing

ASTM A 500/A 500M, Grade B; ASTM A 501.

2.1.5 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B, weight class STD (Standard) and as indicated on drawings.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel, Steel Pipe

2.2.1.1 Bolts

ASTM A 307, Grade A; ASTM A 325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 and ASTM A 490 bolts.

2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

ASTM A 325, Type 1 ASTM A 490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Foundation Anchorage

2.2.3.1 Anchor Bolts

ASTM A 307 and as indicated on drawings.

2.2.3.2 Anchor Nuts

ASTM A 563, Grade A, hex style.

2.2.3.3 Anchor Washers

ASTM F 844.

2.2.4 Load Indicator Washers

ASTM F 959.

2.2.5 Load Indicator Bolts

ASTM A 325, Type 1; ASTM A 490, Type 1, with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.2.6 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C 1107/C 1107M, with no ASTM C 827 shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Fireproofing

Surfaces to receive sprayed-on fireproofing coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201-06 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

3.2 INSTALLATION

3.3 ERECTION

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC 325. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360and AISC 350. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.4.2 High-Strength Bolts

ASTM A 325 and ASTM A 490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Provide load indicator bolts or washers in all ASTM A 325M bolted connections, except provide only load indicator, washers for slip critical connections. Direct tension indicator tightening, or installation of alternate design fasteners, shall be the only acceptable tightening methods. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F 436 washers under both the bolt head and nut when ASTM A 490 bolts are used.

3.5 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officers.

3.6 WELDING

AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.6.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.7 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.7.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.8 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780/A 780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.9 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.9.1 Welds

3.9.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.9.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Contracting Officer and special inspector. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

a. Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Radiographic	all complete penetration butt welds
Ultrasonic	all multi pass fillet welds and complete penetration welds
Magnetic Particle	as required by special inspector
Dye Penetrant	as required by special inspector

3.9.2 Load Indicator Washers

3.9.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

3.9.2.2 Load Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gapson 20 percent of the installed load indicator washers to verify that the ASTM F 959 load indicator gaps have been achieved. If more than 10 percent of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F 959, then all in place load indicator washers shall be tested to verify that the ASTM F 959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

3.9.3 High-Strength Bolts

3.9.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 348, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.9.3.2 Inspection

Inspection procedures shall be in accordance with AISC 348, Section 9. 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.

The Contractor shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

The Contractor shall inspect high-strength bolted connections in accordance with AISC 317.

3.9.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension

requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.9.4 Testing for Embrittlement

ASTM A 143/A 143M for steel products hot-dip galvanized after fabrication.

-- 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) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 449	(2007be1) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 500/A 500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM C 514	(2004; R 2009e1) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 636/C 636M	(2008) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 488	(1996; R 2003) 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

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Within 30 days of Contract Award, submit fabrication drawings to the Contracting Officer for the following items:

a. Iron and Steel Hardware

b. Steel Shapes, Plates, Bars and Strips

c. Steel Railings and Handrails

d. Anchorage and fastening systems

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

a. Masonry anchorage devices

b. Protective coating

c. Steel railings and handrails

d. Anchorage and fastening systems

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

Fabrication Drawings; G
Iron and Steel Hardware; G
Steel Shapes, Plates, Bars and Strips

SD-03 Product Data

Masonry Anchorage Devices; G
Protective Coating; G
Steel and Cable Railings; G(LEED)

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

SD-08 Manufacturer's Instructions

Installation Instructions

SD-11 Closeout Submittals

Steel and Cable Railings(LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all iron and steel 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, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

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.

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 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 MASONRY ANCHORAGE DEVICES

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E 488 and ASTM C 514 as follows:

Provide bolt anchor expansion shields for lag bolts; zinc-alloy, long shield anchors class, Group II, Type 1, Class 1.

Provide bolt anchor expansion shields for bolts; closed-end bottom bearing class, Group II, Type 2, Class 1.

Provide tumble-wing type toggle bolts conforming to ASTM A 325, ASTM A 449 and ASTM C 636/C 636M, type, class, and style as required.

2.4 FASTENERS

Provide galvanized zinc-coated fasteners in accordance with ASTM A 153/A 153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A 307, Grade A.

2.5 PROTECTIVE COATING

Shop prime steelwork with red oxide primer in accordance with SSPC Paint 25.

2.6 STEEL RAILINGS AND HANDRAILS

Design handrails and railings 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.

2.6.1 Steel Railings and Handrails

Provide steel structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength. Provide steel handrails of 1 1/2 inches diameter, nominal size, shop painted and steel railings of 1 1/4 inches diameter, nominal size, shop painted. Provide vertical steel posts of 1 1/2 inches square, nominal size, shop painted. Color as per Section 09 06 90 COLOR SCHEDULE.

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

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Miltered and welded joints made by fitting post to top rail and intermediate rail to post, miltering 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.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

Provide painted steel railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.

Provide kickplates between railing posts where indicated, and consist of 1/8-inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

2.7 STEEL AND CABLE RAILINGS

Provide steel handrails made of structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength. Provide steel handrails of 2 inch square tubing nominal size and steel vertical posts of 1 inch by 2 inch flat bar nominal size, hot-dip galvanized and shop painted. Color as per Section 09 06 90 COLOR SCHEDULE.

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

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints 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.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

Provide galvanized railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Steel railings and posts may contain

recycled content. See Section 01 33 29 LEED DOCUMENTATION for cumulative total recycled content requirements.

b. Cable rails: Provide stainless steel cable railings infill between posts, as indicated:

(1) Provide 1/8 inch diameter, high strength, weather-resistant, Grade 316 Stainless Steel Cable, maximum 4 inches on center.

(2) Tension cable at opposite end posts with Grade 316 Stainless Steel end fittings by manufacturer.

(3) Stainless steel cables shall contain a minimum of 70 percent post-industrial recycled content. Stainless Steel end fittings may contain up to 75 percent post-industrial and up to 50 percent post-consumer recycled content. See Section 01 33 29 LEED DOCUMENTATION for cumulative total recycled content requirements.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of cable hand rails and stair railing:

a. Masonry anchorage devices

b. Steel railings and handrails

c. Anchorage and fastening systems

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

3.2 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 not more than 8 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

Anchor rail ends masonry with 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 of malleable iron castings, 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. Locate brackets not more than 60 inches on center. Provide wall return fittings of cast iron castings, 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 solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

3.3 STEEL HANDRAIL

Install by means of pipe sleeves secured to wood with screws. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts.

3.4 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.

3.5 TOUCHUP PAINTING

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --

SECTION 06 41 16.00 10

LAMINATE CLAD ARCHITECTURAL CASEWORK
08/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(8th Edition) AWI Quality Standards

ASTM INTERNATIONAL (ASTM)

ASTM D 1037	(2006a) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 547	(2006) Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(2003) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	(2009) Medium Density Fiberboard (MDF) For Interior Applications
CPA A208.2	(2009) Medium Density Fiberboard (MDF) for Interior Applications

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 SYSTEM DESCRIPTION

Work in this section includes laminate clad custom casework cabinets vanities as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.2.1 LOCAL/REGIONAL MATERIALS

Use material or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED DOCUMENTATION for cumulative total local material requirements. Submit documentation indicating distance between manufacturing facility and the project site and also the distance of raw material origin from the project site. Submit LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.2.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified. Certification shall be performed annually and shall be current.

1.2.3 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where possible. See Section 01 33 29 LEED DOCUMENTATION, for cumulative total certified wood requirements. Provideletter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers. Include in LEED Documentation Notebook.

1.2.4 Environmental Data

The following shall be submitted in accordance with LEED.

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook. Indicate type and amount of rapidly renewable material in product. Indicate relative dollar value of rapidly renewable content product to total dollar value of products included in project.

c. Documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook. Indicate distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

e. Documentation relative to certified wood credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

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

Shop Drawings; G
Installation

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials; G (LEED)
Plastic Laminate; G (LEED)

Adhesives; G (LEED)
Cabinet Hardware; G

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates; G (LEED)

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size.

Cabinet Hardware; G

One sample of each cabinet hardware item specified to include hinges, pulls, drawer glides.

SD-07 Certificates

Sustanable Design Certificate (LEED)
Forest Stewardship Council (FSC) Certification; G (LEED)
Quality Assurance
Laminate Clad Casework

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

SD-11 Closeout Submittals

Environmental Data (LEED)

Provide documentation relative to recycled content, local/regional materials, low-emitting materials, certified wood, and rapidly renewable materials credit for plastic laminates, wood materials and adhesives, in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

1.4.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400B for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

1.4.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification System Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood. Wood shall be FSC-certified as specified herein. See Section 01 33 29 LEED DOCUMENTATION for cumulative total certified wood requirements.

2.1.2 Panel Products

Products shall be FSC-certified and shall contain no added urea-formaldehyde. Submit data indicting formadelhyde content.

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Qual Stds Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (40 to 50 pounds per cubic foot), 3/4 inch thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered countertops backsplashes and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D 1037 and CPA A208.1. Particleboard shall contain recycled content and/or rapidly renewable material where possible. See Section 01 33 29 LEED DOCUMENTATION.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in CPA A208.2. Where possible, provide MDF products containing recycled content and/or rapidly-renewable material.See Section 01 33 29 LEED DOCUMENTATION.

2.2 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Coordinate with Section 09 06 90 COLOR SCHEDULE. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs. Provide plastic laminates with minimum 15 percent post-industrial recycled content and minimum 9 percent rapidly renewable material content.

2.2.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.2.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.2.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 0.042 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.2.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

2.2.5 Horizontal General Purpose Fire Rated (HGF) Grade

Horizontal general purpose fire rated grade plastic laminate shall be 0.048

inches (plus or minus 0.005 inches) in thickness. Laminate grade shall have a class 1, class A fire rating in accordance with ASTM E 84.

2.2.6 Vertical General Purpose Fire Rated (VGF) Grade

Vertical general purpose fire rated grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade shall have a class 1, class A fire rating in accordance with ASTM E 84.

2.2.7 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.2.8 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.3 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior and drawer interior surfaces.

2.4 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.125 inch thick. Material width shall be 15/16 inches. Color and pattern shall match exposed door and drawer front laminate pattern and color.

2.5 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted.

2.6 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.7 ADHESIVES, CAULKS, AND SEALANTS

2.7.1 Adhesives

Adhesives shall be of a formula and type recommended by the manufacturer. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesive shall meet the requirements LEED low emitting materials credit. VOC content shall be less than the current VOC content limits of GS-36 and SCAQMD Rule 1168. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Provide Material Safety Data Sheets (MSDS) for all primers and adhesives to the Contracting Officer. Highlight VOC emissions.

2.7.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

2.7.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.7.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone. Caulk shall meet the requirements of LEED low-emitting materials credit.

2.7.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture. Sealant shall meet the requirements of LEED low-emitting materials credit.

2.8 ACCESSORIES

2.8.1 Grommets

Grommets shall be rubber material for cutouts. Locations shall be as indicated on the drawings.

2.9 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Qual Stds, Section 400-G descriptions, shall be as indicated on the drawings.

2.9.1 Base and Wall Cabinet Case Body

2.9.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

a. Body Members (Ends, Divisions, Bottoms, and Tops): 3/4 inch medium density fiberboard (MDF) panel product.

b. Face Frames and Rails: 3/4 inch panel product.

c. Shelving: 3/4 inch medium density fiberboard (MDF) panel product.

d. Cabinet Backs: 1/4 inch medium density fiberboard (MDF) panel product.

e. Drawer Sides, Backs, and Subfronts: 1/2 inch panel product.

f. Drawer Bottoms: 1/4 inch medium density fiberboard (MDF) panel product.

g. Door and Drawer Fronts: 3/4-inch medium density fiberboard (MDF) panel product.

2.9.1.2 Joinery Method for Case Body Members

a. Tops, Exposed Ends, and Bottoms.

(1) Steel "European" assembly screws (1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

(2) Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

(3) Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

(4) Spline or biscuit, glued under pressure.

b. Exposed End Corner and Face Frame Attachment.

(1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).

(2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).

(3) Butt joint, glued and nailed.

c. Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

(1) Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

(2) Full overlay, plant-on backs with minimum back thickness of 1/2 inchand minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

(3) Side bound, captured in groove or rabbetts; glued and fastened.

d. Cabinet Backs (Floor Standing Cabinets).

(1) Side bound, captured in grooves; glued and fastened to top and bottom.

(2) Full overlay, plant-on backs with minimum back thickness of 1/2

inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

(3) Side bound, placed in rabbetts; glued and fastened in rabbetts.

e. Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of 3/4 inch particleboard. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density fiberboard (MDF. All door and drawer front edges shall be surfaced with high pressure plastic laminate, color and pattern to match exterior face laminate.

2.9.4 Drawer Assembly

2.9.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

a. Drawer Sides and Back For Thermoset Decorative Overlay (melamine) Finish: 1/2 inch thick medium density particleboard or MDF fiberboard substrate.

b. Drawer Bottom: 1/4 inch thick thermoset decorative overlay melamine panel product.

2.9.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.9.5 Shelving

2.9.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch medium density fiberboard (MDF). All shelving top and bottom surfaces shall be finished with

thermoset decorative overlay (melamine). Shelf edges shall be finished in a thermoset decorative overlay (melamine).

2.9.5.2 Shelf Support System

The shelf support system shall be:

a. Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

b. Pin Hole Method. Holes shall be drilled on the interior surface of the cabinet side walls. Holes shall be evenly spaced in two vertical columns. The holes in each column shall be spaced at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Holes shall be drilled to provide a level, stable surface when the shelf is resting on the shelf pins. Hole diameter shall be coordinated with pin insert size to provide a firm, tight fit.

2.9.6 Countertop Substrate

Countertop substrate shall be constructed of 3/4 inch medium density fiberboard (MDF). The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required. See section 12 36 00 COUNTERTOPS.

2.9.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

(1) Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

(2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

(1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).

(2) All edges: Thermoset Decorative Overlay (melamine).

c. Fixed Shelving.

(1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).

(2) Exposed edges: Thermoset Decorative Overlay (melamine).

d. Door, Drawer Fronts, Access Panels.

(1) Exterior (exposed) and interior (semi-exposed) faces: HPDL Grade VGS.

(2) Edges: HPDL Grade VGS.

e. Drawer Assembly.

All interior and exterior surfaces: HPDL Grade CLS.

f. Countertops and Splashes: All exposed and semi-exposed surfaces: HPDL Grade HGS

g. Tolerances: Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds premium grade requirements.

2.9.8 Finishing

2.9.8.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds premium quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abuts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Countertops

See Section 12 36 00 COUNTERTOPS.

3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds premium grade requirements.

3.1.5 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

-- End of Section --

SECTION 07 42 13

METAL WALL PANELS
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.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Methods of Test for Exterior Walls

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2005; Supp 2005) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set
AISI/COS/NASPEC	(2001, Supplement 2004) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-05	(2006; Errata 2007) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2009a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 606/A 606M	(2009a) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or

	Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(2003; R 2008) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 780/A 780M	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 924/A 924M	(2009a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1308	(2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2244	(2009a) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2009) Measuring Adhesion by Tape Test
ASTM D 3363	(2005) Film Hardness by Pencil Test
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4587	(2005) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and

	Related Coatings
ASTM D 522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 5894	(2005) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2008) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	(2005e1) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

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

SMACNA 1793	(2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 12	(1982; E 2000) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Rev thru Jul 2009) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2009) Building Materials Directory

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

Metal Wall Panel: Metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

1.3 DESCRIPTION OF WALL PANEL SYSTEM

Factory color finished, 24 guage galvanized steel wall panel system with concealed fastening or exposed fastener attachmentas indicated herein. Panel profile must be flush face or corrugated. Provide stiffening ribs in the flat of the panel as per manufacturer's recommendations and as shown on drawings.

1.3.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI/COS/NASPEC, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM A 1008/A 1008M
ASTM A 123/A 123M
ASTM A 36/A 36M
ASTM A 653/A 653M
ASTM A 606/A 606M
ASTM A 755/A 755M for metallic coated steel sheet for exterior coil pre-painted applications.
ASTM A 780/A 780M for repair of damage or uncoated areas of hot-dipped galvanized coating.
ASTM A 924/A 924M for metallic coated steel sheet
ASTM D 522 for applied coatings
UL Bld Mat Dir

1.3.2 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 design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections 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 load and stress requirements in accordance with ASTM E 1592. 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 UL 580 and ASCE 7-05 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of wind load tests and seismic tests to the Contracting Officer.

Provide metal wall panel assembly for seismic conditions complying with the applicable requirements of AISC 341.

1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E 283.

1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E 331.

1.3.5 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

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

Submit Documentation for the following items:

Qualification of Manufacturer
Qualification of Installer
Sample Warranty; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Wall Panels; G (LEED)

Closure Materials
Pressure Sensitive Tape
Sealants and Caulking (LEED)
Steel Repair Paint
Accessories; G

Documentation indicating percentage of recycled content and compliance with LEED low-emitting materials credit requirements.

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G
Fasteners; G
Metal Closure Strips, 10 inches long of each type; G

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

SD-05 Design Data

As applicable, submit the following wind load design analysis; G 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

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests; G
Wind Load Tests; G
Coatings and Base Metal Tests

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels

SD-09 Manufacturer's Field Reports

Submit two bound copies of the Manufacturer's Field Reports; G

SD-11 Closeout Submittals

Warranty; G
Maintenance Instructions
20 year "No Dollar Limit" warranty for labor and material; G
Wall panels; (LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Sealants and Calking; (LEED)

1.5 Other Submittal Requirements

The following shall be submitted in accordance with LEED:

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

b. Documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.6 QUALITY ASSURANCE

1.6.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the Contracting Officer; and prior to the commencement of the work, the Contractor must attend a pre-installation conference to review the following:

a. Drawings and Specifications.

b. Qualification of Installer.

c. Sustainable acquisition - Provide steel panels containing recycled content by weight.

d. Sample Warranty

e. Sample wall panels, 12 inches long by actual panel width

f. Sample metal closure strips, 10 inches long of each type

g. Color charts and chips

h. Coatings and base metal tests, chalking tests

i. Construction schedule, availability of materials, Installer's personnel, equipment and facilities required to progress with the work without delay.

j. Methods and procedures related to installation of wall panels, including manufacturer's written instructions. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

k. Support conditions for compliance with requirements, including alignment between and attachment to structural members.

l. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.

m. Governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

n. Temporary protection requirements for metal wall panel assembly during and after installation.

o. Wall panel observation and repair procedures after metal wall panel installation. Provide detailed written instructions including copies of Material Safety Data Sheets for maintenance and repair materials, and manufacturer's maintenance instructions.

1.6.1.1 Installation Drawings

Installation shop drawings for wall panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

1.6.1.2 Wind Load Design Analysis

Wind design analysis must include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis must be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

1.6.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.6.3 Qualification of Manufacturer

Certify that metal wall panel system manufacturer has a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

Manufacturer must also provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures per MBMA MBSM, "Metal Building Systems Manual"; ASCE 7-05, and ASTM E 1592 and seismic design conforming to AISC 341.

Provide certified engineering calculations, using the products submitted, for Wind load requirements in accordance with ASCE 7-05.

1.6.3.1 Manufacturer's Certificates

Provide evidence that products used within this specification are manufactured in the United States.

1.6.4 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal

wall panel manufacturer prior to beginning the installation of the metal wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

1.6.5 Single Source

Obtain each type of metal wall panels, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.7 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets, metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.8 PROJECT CONDITIONS

1.8.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.8.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.9 WARRANTY

Warranty must conform to the Sample Warranty as reviewed and approved by the Contracting Officer at the Pre-Installation Conference.

1.9.1 20 Year 'No Dollar Limit Warranty for Labor and Material

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty

are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 FABRICATION

Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Fabricate metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

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 attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.2 PANEL MATERIALS

2.2.1 Steel Sheet

Roll-form steel wall panels to the specified profile, 24 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A 653/A 653M and AISI SG03-3.

b. Individual panels must be continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed

without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

i. Profile to be a 7/8 inch high corrugated rib at 2.667 inches o.c., 39.75 inch overall width with minimum 36 inch coverage and exposed fasteners.

ii. Smooth, flat surface texture, 1 inch interlocking flush panels with concealed fasteners at 12 inches o.c.

d. Provide steel wall panels containing a minimum of 25 percent post-consumer and 5 percent post-industrial recyled content. See Section 01 33 29 LEED DOCUMENTATION for cumulative total recyled content for project.

2.2.2 Factory Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in 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 contrast.

All panels are to receive a factory-applied non-weathering polyvinylidene fluoride Kynar 500 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.2.2.1 Metal Preparation

Carefully prepare all metal surface 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 acid rinse, and thorough drying.

2.2.2.2 Prime Coating

Apply a base coat of polyester primer, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 + 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.2.2.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 + 5 mils (3.80 + 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 + 0.10 mils (4.00 + 0.10 mils for Vinyl Plastisol). Oven-cure finish coat.

2.2.2.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 + 0.05 mils for a total dry film thickness of 0.50 + 0.10 mils. Oven-cured the wash coat. Interior coating shall be low-VOC and comply with LEED low-emitting materials credit requirements.

2.2.2.5 Color

Provide exterior finish color as specified: Mettalic warm-toned gray ("Champagne") color with minimum SRI of 55 at corrugated metal wall panels and at flush panel wall, trim, and soffit conditions, where indicated. Mettalic copper color with minimum SRI of 45 shall be provided at flush panel wall, fascia, and soffit conditions where indicated. See Section 09 06 90 COLOR SCHEDULE.

2.2.2.6 Physical Properties

Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General: SSPC Paint 12, NAVFAC A-A-50570, ASTM D 5894, and ASTM D 4587.
Abrasion: ASTM D 968
Adhesion: ASTM D 3359
Chalking: ASTM D 4214
Chemical Pollution: ASTM D 1308
Color Change and Conformity: ASTM D 2244
Creepage: ASTM D 1654
Cyclic Corrosion Test: ASTM D 5894
Flame Spread: ASTM E 84
Flexibility: ASTM D 522
Formability: ASTM D 522
Gloss at 60 and 85 degrees: ASTM D 523
Humidity: ASTM D 2247 and ASTM D 714
Oxidation: ASTM D 610
Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Salt Spray: ASTM B 117
Weatherometer: ASTM G 23 and ASTM D 822

2.3 MISCELLANEOUS METAL FRAMING

Cold-formed metallic-coated steel sheet conforming to ASTM A 653/A 653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless other wise indicated.

2.3.1 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to supporting members and substrates in accordance with the wall panel manufacturer's and ASCE 7-05 requirements.

2.4 FASTENERS

2.4.1 General

2.4.1.1 Exposed Fasteners

Provide corrosion resistant fasteners for wall panels, made of coated steel, aluminum, 300 - series corrosion resisting stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads.

Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.4.1.2 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

2.4.1.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or 300 - series stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.4.1.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.4.1.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A 653/A 653M, Z275 G 90 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.5 ACCESSORIES

2.5.1 General

All accessories must be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.5.2 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber conforming to ASTM D 1056 and ASTM D 1667; extruded or molded to the configuration of the specified wall panel and in lengths supplied by the wall panel manufacturer.

2.5.3 Metal Closure Strips

Provide factory fabricated steel closure strips to be the same gauge, color, finish and profile of the specified wall panel.

2.5.4 Joint Sealants

2.5.4.1 Sealants and Caulking

Provide approved gun type sealants for use in hand- or air-pressure calking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F minus) with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable

surface skin which permit remaining soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.5.4.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C 920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.5.4.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C 920, Type II. Color to match panel colors.

2.5.4.4 Pressure Sensitive Tape

Provide pressure sensitive tape sealant, 100% solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

2.6 SHEET METAL FLASHING AND TRIM

2.6.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.7 REPAIR OF FINISH PROTECTION

Repair paint for color finish enameled wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer. Provide of steel repair paint matching the specified wall panels.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer, UL, ASTM, ASCE 7-05 and as required for the

geographical area where construction will take place.

Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

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

3.2 PREPARATION

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment. Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

3.3 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.

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.

3.3.1 Steel Wall Panels

Use stainless-steel fasteners for exterior surfaces and galvanized steel fasteners for interior surfaces, as per manufacturer's written instructions.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.4 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.

3.5 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, 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.

3.5.2 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.

3.5.3 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.

3.6 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 in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Finished application of metal wall panels are to be subject to inspection and test for air and/or moisture leakage by request of the Contracting Officer, Architect/Engineer. Conduct inspection and tests at no cost to the Government.

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

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. 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 Contracting Officer are to be immediately removed and replaced with new material.

3.7.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 FIELD QUALITY CONTROL

3.8.1 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 wall 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 accord with the specified requirements.

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

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work 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.

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

-- End of Section --

SECTION 07 54 19
THERMOPLASTIC POLYEOLEFIN (TPO) ROOFING
11/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D 4434	(2006) Poly(Vinyl Chloride) Sheet Roofing
ASTM D 6754	(2002) Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E 108	(2007a) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2005) Approval Guide

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	(2001; R 2003, 5th Ed) Roofing and Waterproofing Manual

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Rev thru Oct 2008) Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2008) Roofing Materials and Systems Directory

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

Mechanically fastened TPO roof membrane system applied over insulation substrate.

1.2.1 General

Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Membrane shall be free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Insulation shall be applied and weatherproofed on the same day.

1.2.2 Fire Resistance

Complete roof system assembly shall:

a. Be Class A rated in accordance with ASTM E 108, FM 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM P7825 or FM RoofNav (www.roofnav.com).

FM or UL approved components of the roof covering assembly shall bear the appropriate FM or UL label.

1.2.3 Wind Uplift Resistance

Complete roof covering assembly, including insulation, shall be rated Class 1-90 in accordance with FM RoofNav (www. roofnav.com) or FM P7825 and capable of withstanding an uplift pressure of 90 psf. Non-rated systems shall not be installed. Provide wind load calculations and submit engineering calculations and substantiating data to validate wind resistance of any non-rated roof system. Base wind uplift calculations on a design wind speed of 90 mph in accordance with ASCE 7 or applicable building code 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

Detail Drawings; G

Roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, location of perimeter half-sheets, spacing of perimeter, corner, and infield fasteners, as applicable. The drawing shall reflect the project roof plan of each roof level and conditions indicated.

SD-03 Product Data

TPO Roofing Membrane; G (LEED)

Manufacturer's descriptive data documenting that the product meets the minimum solar reflectance index (SRI) requirements. Highlight SRI values.

Bonding Adhesive; G (LEED)

Manufacturer's descriptive data including instructions for applications, storage requirements, curing time, and test requirements. Highlight VOC content and comply with LEED low-emitting materials credit requirements.

Flashing
Membrane Fasteners and Plates
Roof Insulation; G
Water Cutoffs
Information Card; G

Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer. Products shall be as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

Wind uplift calculations; G

Engineering calculations validating the wind resistance of roof system.

SD-07 Certificates

Qualifications of Applicator; G

Certificate stating that the applicator meets requirements specified.

Wind Uplift Resistance; G
Fire Resistance; G

Roof system assembly wind uplift and fire rating classification listings.

warranty; G

Sample certificate

SD-08 Manufacturer's Instructions

Application Method; G

Instructions including pattern and frequency of mechanical attachments required in the field for roof, corners, and perimeters to provide for the specified wind resistance

Membrane Flashing
Perimeter Attachment

Auxiliary Fasteners

cold weather

Detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-10 Operation and Maintenance Data

Instructions to Government Personnel

Copies of Material Safety Data Sheets for maintenance/repair materials.

SD-11 Closeout Submittals

TPO Roofing Membrane (LEED)

LEED documentation relative to the roof heat island effect credit in accordance with the LEED Reference Guide. Include SRI compliance data in the LEED Documentation Notebook.

Bonding Adhesive (LEED)

LEED documentation relative to the low-emitting materials credit in accordance with the LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Applicator

TPO membrane roofing system Applicator shall be approved, authorized, or licensed in writing by the TPO membrane roof manufacturer and shall have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer's TPO membrane roofing materials and be approved at a level capable of providing the specified warranty. The applicator shall supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.2 Conformance and Compatibility

The entire roofing and flashing system (including edge metal) shall be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the NRCA 0405, membrane manufacturer published recommendations and details and shall be compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer and TPO roof membrane manufacturer for approval prior to installation.

1.4.3 Preroofing Conference

After approval of submittals and before performing roofing and insulation

system installation work, hold a preroofing conference to review the following:

a. Drawings, specifications and submittals related to the roof work;

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Preroofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.5.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers and other liquid materials above 60 degrees F. Insulated hot boxes or other enclosed warming devices may be required in cold weather subject to TPO membrane roofing manufacturer's printed instruction. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each days work.

1.5.3 Handling

Prevent damage to roll materials. Damaged materials shall not be installed

in the work. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure, incompatible materials or moisture. Remove contaminated materials from the site. When hazardous materials are involved, conform with the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.6 ENVIRONMENTAL REQUIREMENTS

Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.8 WARRANTY

Provide a Full System Roof Warranty covering all TPO membrane roof system components as well as their installation workmanship and meeting all specified requirements. Revision or amendment to standard full system TPO membrane manufacturer warranty shall be provided as required to comply with the specified requirements.

1.8.1 TPO Membrane Manufacturer's Full Roof System Warranty

Furnish roof membrane manufacturer's 15-year, no dollar limit, full roof system materials and installation workmanship warranty, including all flashing, insulation, and accessory materials necessary to construct a complete, watertight roof system. The warranty shall run directly from the roof system manufacturer to the Government and commence at time of Government's acceptance of the roof work. The warranty shall state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, shrinks to the point of significant bridging or tenting membrane at transitions, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship shall be the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the roof membrane manufacturer.

b. When the manufacturer and his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others shall not void the warranty.

1.8.2 Roofing System Installer Warranty

The roof system installer shall warrant for a period of not less than five (5) years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, all attachments, including installation of all TPO membrane manufacturer-supplied edge metal which is always integral to a complete watertight roof system assembly. The warranty shall run directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials shall be the responsibility of the roof system installer. All costs associated with the repair or replacement work shall be the responsibility of the installer.

1.8.3 Continuance of Warranty

Any repair or replacement work that becomes necessary within the warranty period shall be approved by the roof membrane manufacturer and accomplished in a manner so as to restore the integrity of the roof system assembly and the validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.8.4 Single-Source Contract Liability Warranty

The specified, single-source contract liability warranty of a TPO membrane roofing system manufacturer shall be furnished to the Government upon project completion. The single-source contract liability warranty shall encompass all roof system components' warranty performance coverage's, including all performance guarantees for roof system materials, roof system design and all roof system installation labor and workmanship. The single-source contract liability warranty shall be a Full Roof System Warranty that is issued by either the TPO membrane roof system manufacturer, or by a direct affiliate of the TPO membrane roof system manufacturer (100 percent owned affiliate), or by an agent of the TPO membrane roof system manufacturer possessing the authority to contractually bind the TPO membrane roof system manufacturer (manufacturer, affiliate and agent are collectively referred to as "Roofing System Supplier") and to, at said agent's discretion, underwrite and/or provide for insurance covering all of the respective warranty obligations of the TPO membrane manufacturer's Full Roof System Warranty.

a. The Government intends to sign a contract binding all warranty and associated roof system performance guarantees of the roofing system directly with the TPO membrane roofing manufacturer, or it's subsidiary, or an exclusive agent capable of enjoining said TPO membrane manufacturer; and

b. This roofing system shall be applied only by a roofing system Applicator authorized by the TPO membrane roofing manufacturer prior to bid; and

c. The roofing system Applicator shall arrange with, and make arrangements to the satisfaction and discretion of the TPO Roofing System Supplier, to have the services of a Technical Field Representative on site full time to observe the total roof application, including removal of pre-existing roofing (if applicable). The Technical Field Representative shall provide written daily reports to the Roofing System Supplier and Applicator. The roofing system Applicator shall include the cost of the full-time Technical Field Representative in his/her bid price; and

d. Bids must be submitted with approved detail drawings and specifications approved and furnished by the TPO membrane manufacturer, and

e. There shall be no deviation made from the contract specification or the approved shop/detail drawings without prior written approval by the both TPO membrane roofing material manufacturer/subsidiary and by the Government; and

f. All work shall be completed by personnel trained and authorized by the TPO membrane roof manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Materials provided shall be free of defects and suitable for the service and climatic conditions of the installation. All warranted roof system components must be sourced from the TPO roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.

b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

2.1.1 Bonding Adhesive

Provide TPO membrane manufacturer's low volatile organic compound (VOC) membrane adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of TPO membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Bonding adhesive shall not be used to bond membrane materials to each other. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide for all adhesives and sealants.

2.1.2 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.3 Membrane Flashing

Membrane flashing, including self-adhering membrane flashing, perimeter

flashing, flashing around roof penetrations and prefabricated pipe seals, shall be minimum polymer thickness 0.045 inch reinforced TPO for 5, 10, 15 year warranties, and shall be utilized as recommended and supplied by the roof membrane manufacturer or minimum 0.060 inch thick reinforced TPO roof membrane and flashing's for 20 year warranties.

2.1.4 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the TPO roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM P7825 for Class I roof deck construction and the wind uplift resistance specified. Fasteners and Plates to be supplied and warranted for the substrate type(s) by TPO membrane manufacturer and recommended by TPO membrane manufacturer's printed data.

2.1.4.1 Stress Plates, Bar or Rail for Fasteners

Corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470 must be utilized and must be supplied by TPO roof membrane manufacturer. Stress plates shall be formed to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.4.2 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors must be suitable for intended attachment purpose and be recommended and supplied for use by the TPO roof membrane manufacturer.

2.1.5 Pre-manufactured Accessories

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, must comply with applicable specification section, be compatible with the membrane roof system and approved for use and supplied by the TPO roof membrane manufacturer. Pre-fabricated Curbs shall be gauge G90 galvanized with minimum 4 inch flange for attachment to roof nailers. Curbs shall provide minimum height of 10 inches above the finished roof membrane surface.

2.1.6 TPO Walk Tread

Provide the following: TPO Walk Tread

2.1.6.1 TPO Walk Tread

Scrim reinforced 0.096 inch thickness TPO membrane with a textured surface, compatible with and supplied by manufacturer of the TPO roof membrane.

2.1.7 Roof Insulation

Insulation system and facer material shall be compatible with membrane application specified and be approved and supplied by the TPO membrane roof manufacturerand as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.1.8 Wood Products

Fire retardant treated materials shall not be in contact with TPO membrane or TPO accessory products, unless approved by the membrane manufacturer and

the Contracting Officer.
Text

2.2 Reinforced TPO Membrane

Reinforced polyvinyl chloride (TPO) membrane shall contain fibers or scrim, and shall comply with ASTM D 4434, Type II, Grade I or Type III or Type IV, fleece backed, or ASTM D 6754, and in all cases shall provide 0.045 inch minimum thickness for mechanically fastened application. Not withstanding the ASTM standards referenced, reinforced TPO roof membranes provided under this section shall have the minimum, labeled thickness specified. TPO membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Principal polymer used in manufacture of the membrane sheet shall be TPO. Width and length of TPO membrane roofing sheet shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced TPO membrane roofing sheet dimensions to be the maximum width obtainable from TPO membrane roof manufacturer in order to minimize seams in the field of the roof.

2.2.1 Color Finish

Factory Color finish as per Section 09 06 90 COLOR SCHEDULE. Roofing membrane shall have a solar reflectance index (SRI) equal to or greater than 78. Comply with roof heat island effect credit requirements of the LEED Reference Guide.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

c. Substrate is sloped to provide positive drainage.

d. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

e. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

f. Pressure-preservative treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Embedded nailers are flush with deck surfaces. Surface-applied nailers are the same thickness as the roof insulation.

g. Avoid contact of TPO materials with fire retardant treated wood, except as approved by the TPO membrane roof manufacturer and

Contracting Officer.

h. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is attached as specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.

3.2 APPLICATION METHOD

Apply entire TPO membrane roofing utilizing mechanically fastened application method. Apply roofing materials as per manufacturer recommendations and/or herein. Manufacturer recommendations prevail over those here listed.

3.2.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning TPO sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the TPO membrane roofing sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.2.2 TPO Roofing Membrane

Only felt-backed membrane shall be placed directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Non-felt-backed TPO membrane roofing sheet shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Membrane shall be overlapped a minimum of 3 inches at sides for adhered applications and 5.5-7 inchesfor mechanically fastened applications and minimum 4 inches at ends. Where possible, direction of laps shall allow water to flow over and not into the lap. Membrane joints shall be free of

wrinkles and fishmouths. The entire length of hot-air-welded seams shall be probe-tested and corrected during the day of installation. Defective areas shall be re-welded. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a continuous hot-air-welded seam on all sides. Repairs shall be probe-tested for continuity. Hot-air-welded seams are to be accomplished in accordance with the TPO membrane roofing manufacturer's published requirements.

3.2.2.1 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 4 inch centers maximum; screws for sheet metal shall be staggered on 8 inch centers maximum; and a row of fasteners shall be at least 1/2 inch from edges of sheet metal.

3.2.2.2 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam shall be sealed a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashing's shall be secured at the top of the flashing a maximum of 12 inches on centers under the counterflashing or cap. Where possible, prefabricated components shall be used for pipe seals and flashing accessories.

3.2.2.3 Expansion Joints

Expansion joints shall be covered using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.2.2.4 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

3.2.2.5 Walkways

Walkways shall be installed on a loose-laid pad of the membrane material extending at least 1 inch beyond the walkway material, and as specified by the manufacturer. Stone ballast shall not be placed below or above walkways.

3.2.3 Mechanically Fastened Membrane Application

Layout membrane and lap adjoining sheets in accordance with membrane manufacturer's printed instructions such that the minimum recommended seam width is maintained and to ensure that seam width is as required by tested assembly meeting specified wind resistance requirements. Account for additional overlap required for placement of fasteners and plates or battens beyond the closed seam. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Mechanically secure the membrane sheet with specified fasteners in the lap area. Space fasteners as required to provide the wind uplift resistance specified and in accordance with submitted fastener patterns for the field, corner, and perimeter roof areas. Set fasteners firm to plate or batten. Form field hot-air-welded seams and laps

and/or coverstrips, as specified. Check all seams and ensure full/continuous lap seal.

3.2.4 Perimeter Attachment

Mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond shall be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.2.5 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 12 inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

3.2.6 Membrane Flashing

a. Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize reinforced TPO membrane flashing and prefabricated accessory flashing's as recommended by the roof membrane manufacturer.

b. Completely adhere flashing sheets in place. Hot-air-weld the seams of flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 12 inches on center. Sheet metal counter-flashing shall be installed over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply reinforced TPO flashing membrane over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated. Metal flashing's are specified under Section 07 60 00 FLASHING AND SHEET METAL.

c. Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, are specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide a tapered insulation sump into the drain bowl area. Tapered slope shall not exceed 15 degrees (3:12) for fiberglass reinforced TPO membrane. Tapered insulation shall have surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 24 inches of roof drain, or as otherwise recommended by the roof membrane manufacturer.

d. Adhere the membrane to the tapered insulation in the drain sump area. Apply TPO membrane manufacturer's compatible sealant and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application

instructions. Membrane shall be free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes.

3.2.7 Pre-fabricated Curbs

Prefabricated curbs shall be securely anchored to nailer or other base substrate and flashed with TPO membrane flashing materials.

3.2.7.1 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.2.7.2 Lightning Protection

Lightning protection system components shall be flashed or attached to the roof membrane in a manner acceptable to the TPO membrane roof manufacturer and compliant with Code requirements.

3.2.8 Roof Walkways

Install walkways at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the TPO membrane roof manufacturer's printed instructions.

3.2.9 Correction of Deficiencies

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions shall be as directed by the Contracting Officer.

3.2.10 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.3 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.3.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.3.2 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.4 FIELD QUALITY CONTROL

3.4.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

(2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(3) The proper number, type, and spacing of fasteners are installed.

(4) Materials comply with the specified requirements.

(5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

(6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.

(7) Membrane is properly overlapped.

(8) Membrane seaming is as specified by TPO membrane manufacturer. All seams are checked at the end of each work day.

(9) Applied membrane is inspected and repaired as necessary prior to paver installation.

(10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.

(11) Installer adheres to specified and detailed application parameters.

(12) Associated flashing's and sheet metal are installed in a

timely manner in accord with the specified requirements.

(13) Paver ballast is within the specified weight range.

(14) Temporary protection measures are in place at the end of each work shift.

3.4.2 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of 3 times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections shall occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the roofing Contractor to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.6 ROOF DRAIN TEST

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

-- End of Section --

SECTION 07 61 14.00 20

STEEL STANDING SEAM ROOFING
08/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2009a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 366/A 366M	(1997e1) Standard Specification for Commercial Steel, Sheet, Carbon,(0.15 Maximum Percent Cold-Rolled
ASTM A 570/A 570M	(1998) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D 2244	(2009a) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 522	(1993a; R 2008) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 968	(2005e1) Abrasion Resistance of Organic

	Coatings by Falling Abrasive
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

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

SMACNA 1793	(2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Snap Together Seam

Panels so configured that the male and female portions of the seam interlock through the application of foot pressure or tamping with a mallet. Snap-on cap configurations are a type of snap together system.

1.2.3 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.4 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.5 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

a. Panels shall be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets shall be in continuous contact from eave to ridge. Individual panels of snap together type systems shall be removable for replacement of damaged material.

b. There shall be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel shall be stainless steel, zinc cast head, or cadmium plated steel screws inserted into predrilled holes. There shall be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.

c. Snap together type systems shall have a capillary break and a positive side lap locking device. Field-formed seam type systems shall be mechanically locked closed by the manufacturer's locking tool. The seam shall include a continuous factory applied sealant when required by the manufacturer to withstand the wind loads specified.

d. Roof panel anchor clips shall be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

The system shall be designed to resist positive and negative loads specified herein in accordance with the AISI SG03-3. Panels shall support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of 90 miles per hour (mph). Roof system and attachments shall resist the following wind loads, in pounds per square foot (psf):

		Negative
a.	At eaves	49.2
b.	At ridge	49.2
c.	At building corners	72.7
d.	At central areas	28.3

Negative

The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

a. Single fastener in a connection: 3.0

b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be 20 psf.

1.3.2.3 Thermal Movement

System shall be capable of withstanding thermal movement based on a temperature range of 10 degrees F below design low air temperature

1.3.2.4 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) shall be in accordance with ASTM E 1592.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Roofing; G (LEED)

Submit roofing drawings to supplement the instructions and diagrams. Drawings shall include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA 1793. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Roofing panels; G
Attachment clips
Closures
Accessories
Fasteners
Sealants; G (LEED)

Insulation, including joint sealing measures for vapor barrier facing

Sample warranty certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture selected. When colors are not indicated, submit samples of not less than six different manufacturer's standard colors for selection.

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

Sealants
Intermediate Support Section

Submit full size samples of each intermediate support section, 12 inches long.

SD-05 Design Data

Design calculations; G

SD-06 Test Reports

Field Inspection; G

Submit manufacturer's technical representative's field inspection reports as specified in paragraph entitled "Manufacturer's Field Inspection."

Structural performance tests; G
Finish tests

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications; G

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer to install the products specified.

SD-08 Manufacturer's Instructions

Installation manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information card; G

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

Roofing Panels; (LEED)

LEED documentation relative to the roof heat island effect credit in accordance with the LEED reference guide. Include SRI values in the LEED Documentation Notebook.

LEED documentation relative to the recycled content materials credit requirements,in accordance with the LEED reference guide. Include in LEED Documentation Notebook.

Sealants; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with the LEED reference guide. Include in LEED Documentation Notebook.

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph entitled "Wind Uplift."

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing and insulation work, including associated work, is preformed, the Contractor shall hold a preroofing conference to review the following:

a. The drawings and specifications

b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system

c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing and insulation installation, mechanical and electrical work, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun. Prepare written minutes of the preroofing conference and submit to the Contracting Officer.

1.6.2 Manufacturer

The SSMRS shall be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative shall be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer shall be factory-trained, approved by the metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer; shall be the latest design by the manufacturer; and shall have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels shall meet the following test requirements:

a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D 522, exterior coating film shall show only slight microchecking and no loss of adhesion.

b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G 23, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument shall be considered to indicate loss of adhesion.

c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating shall not chalk greater than No. 8 rating when measured in accordance with ASTM D 4214 test procedures.

d. Color Change Test:

After the 2000 -hour weatherometer test, exterior coating color change shall not exceed 2 NBS units when measured in accordance with ASTM D 2244 test procedure.

e. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D 968, coating system shall withstand a minimum of 100 liters of sand per mil thickness before appearance of base metal.

f. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage, or corrosion.

g. Gloss Test: The gloss of the finish shall be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D 523.

h. Glare Resistance Test:

Surfaces of panels that will be exposed to the exterior shall have a specular reflectance of not more than 10 when measured in accordance with ASTM D 523 at an angle of 85 degrees. Specular reflectance may be obtained with striations or embossing. Requirements specified under "Formability Test" will be waived if necessary to conform to this requirement.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period shall be not less than 20 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. The Contractor shall also provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Damaged or permanently stained materials that cannot be restored to like-new condition shall be replaced with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Panels shall have interlocking ribs for securing adjacent sheets. System for securing the roof covering to structural framing members shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps shall be predrilled or prepunched; factory prepare ends of panels to be lapped by trimming part of seam, die-setting or swaging ends of panels. Length of sheets shall be sufficient

to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. When length of run exceeds 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide not less than 16 inches of coverage in place. Height of corrugations of adjacent roof sheets shall be not less than 2.25 inches (nominal). Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Panels from coil stock shall be formed without warping, waviness or ripples not part of the panel profile and shall be free of damage to the finish coating system.

2.1.1 Material

Galvanized steel conforming to ASTM A 653/A 653M, G90 coating designation. Minimum thickness to be 0.023 inch thick (24 gage) minimum except when mid field of roof is subject to design wind uplift pressures of 60 psf or greater, entire roof system shall have a minimum thickness of 0.030 inch (22 gage).

2.1.2 Texture

Smooth.

2.1.3 Finish

Factory color finish. See Section 09 06 90 COLOR SCHEDULE.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally-cured, non-weathering coating to exterior and interior of metal roof and wall panels and metal accessories. Roofing finish shall have a Solar Reflectance Index (SRI) of 45, but no less than 29. Comply with the roof heat island effect credit requirements of the LEED Reference Guide.

All steel roofing panles are to recieve a factory applied non-weathering polyvinylidene flouride Kynar 500 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat.

2.1.4 Environmental Data

Steel is known to contain high amounts of recycled content and may contribute to LEED recycled content credits. See Section 01 33 29 LEED Documentation for cumulative total of recycled content for project. Provide roofing panels containing a minimum of 25 percent post-consumer and 5 percent post-industrial recycled content.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A 653/A 653M, G90, Grade D (16 gage and heavier), Grade A (18 gage and lighter); or steel conforming to ASTM A 36/A 36M, ASTM A 570/A 570M, or ASTM A 1008/A 1008M prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A 366/A 366M, ASTM A 570/A 570M, or

ASTM A 1008/A 1008M steel hot-dip galvanized in accordance with ASTM A 653/A 653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, gutters, downspouts, trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal shall be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures shall not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material shall not absorb water.

2.4.2 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4.2.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

2.4.2.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against

the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than one inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt and low VOC content, complying with SCAQMD Rule 1168. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant shall be the non-hardening type. Seam sealant shall be factory-applied, non-skinning, non-drying, and shall conform to the roofing manufacturer's recommendations. Silicone-based sealants shall not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer. Comply with low-emitting materials credit in accordance with the LEED Reference Guide.

2.4.4 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.5 THERMAL INSULATION

Flexible blanket, rigid, or semi-rigid faced with a flexible vapor retarder. Insulation and facing shall have a flame-spread rating of 50 or less in accordance with ASTM E 84. Vapor retarder facing shall have a permeance rating of 0.05 perm or less. Provide a thermal resistance "R" value of 30 or more. Facings and finishes shall be factory-applied.

2.6 LINER PANELS

Fabricate liner panels of the same material as roof panels, and formed or patterned to prevent waviness and distortion. Liner panels shall have a factory applied, one mil thick minimum painted coating on the inside face and a prime coat on the liner side.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels shall be in full and firm contact with attachment clips. Where prefinished panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened. Provide one layer of asphalt-saturated felt placed perpendicular to roof slope, covered by one layer of rosin-sized building paper placed parallel to roof slope with side laps down slope and attached with roofing nails. Overlap side and end laps 3 inches, offset seams in building paper with seams in felt.

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the junction of ventilators, curbs, skylights, chimneys, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels. Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment shall allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Insulation Installation

Insulation shall be installed between covering and supporting members to present a neat appearance. Fold and staple and tape seams unless approved otherwise by the Contracting Officer.

3.3.2.1 Rigid or Semi-Rigid Insulation

Install in areas where insulation is exposed to view. Fasten securely without loose joints or unsightly sags.

3.3.2.2 Blanket Insulation

May be used in concealed locations. Lap facing at joints and fasten in a manner that will provide tight joints.

3.3.3 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated shall be in accordance with the SMACNA 1793, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.4 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay. Drive exposed penetrating type fasteners normal to the surface and to a uniform depth to seat gasketed washers properly and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered. Do not drill through sealant tape. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels.

3.3.5 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the

Contracting Officer. Additional inspections shall not exceed one for 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date. After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.7 COMPLETED WORK

Completed work shall be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.8 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inchthick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated.

3.9 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. Deck/Substrate Type:

4. Slopes of Deck/Roof Structure:

5. Insulation Type & Thickness:

6. Insulation Manufacturer:

7. Vapor Retarder: ( )Yes ( )No

8. Vapor Retarder Type:

9. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name:
c. Width:
d. Gage:
e. Base Metal:
f. Method of Attachment:

10. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

11. Statement of Compliance or Exception:_____
_____
_____

12. Date Roof Completed:

13. Warranty Period: From_____ To_____

14. Roofing Contractor (Name & Address):

15. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:

-- 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 C 1311	(2002) Standard Specification for Solvent Release Agents
ASTM C 734	(2006) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 919	(2008) Use of Sealants in Acoustical Applications
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 217	(2002; R 2008) Cone Penetration of Lubricating Grease
ASTM D 2452	(2003; R 2009) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D 2453	(2003; R 2009) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building

Rating System for New Construction
(LEED-NC)

1.2 SUBMITTALS

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

SD-03 Product Data

Sealants; G (LEED)
Primers (LEED)
Bond breakers
Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material. Highlight VOC content and comply with LEED low-emitting materials credit requirements.

SD-07 Certificates

Sealant

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

SD-11 Closeout Submittals

Sealant (LEED)
Primers (LEED)

LEED documentation relative to low-emitting materials credit in accordance with the LEED Reference Guide. Include in LEED Documentation Notebook.

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

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide for all interior sealants. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As selected
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As selected
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	As selected
e.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected
f.	Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	As selected
g.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar	As selected

LOCATION	COLOR
materials; joints occurring where substrates change.	
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Joints between new and existing exterior masonry walls.	Match adjacent surface color
c. Masonry joints where shelf angles occur.	Match adjacent surface color
d. Expansion and control joints.	Match adjacent surface color
e. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
f. Voids where items pass through exterior walls.	Match adjacent surface color
g. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
h. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
i. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	Match adjacent surface color

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Seats of metal thresholds for	As selected

LOCATION	COLOR
exterior doors.	
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As selected

2.1.4 Acoustical Sealant

Rubber or polymer-based acoustical sealant conforming to ASTM C 919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and must be non-staining. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide.

2.1.5 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application. Comply with SCAQMD Rule 1168 in accordance with the LEED Reference Guide.

2.3 BOND BREAKERS

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

2.4 BACKSTOPS

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

2.4.1 Rubber

Conform to ASTM D 1056, Type 1, open cell, or Type 2, closed cell.

2.4.2 PVC

Conform to ASTM D 1667, Grade VO 12, open-cell foam, round cross section for Polyvinyl chloride (PVC) backing.

2.4.3 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.4.4 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C 1311.

2.4.5 Silicon Rubber Base

Provide Silicon Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C 920, Non-sag.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453.

2.6 CLEANING SOLVENTS

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

PART 3 EXECUTION

3.1 SURFACE PREPARATION

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

3.1.1 Steel Surfaces

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

3.1.2 Aluminum or Bronze Surfaces

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

3.1.3 Concrete and Masonry Surfaces

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

3.2 SEALANT PREPARATION

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

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For, concrete, masonry,		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch.	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

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

3.3.6 Sealants

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

3.4 PROTECTION AND CLEANING

3.4.1 Protection

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

3.4.2 Final Cleaning

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

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

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

-- End of Section --

SECTION 08 14 00

WOOD DOORS
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 E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	(2000) Principles and Criteria for Forest Stewardship

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1113	(2004) Architectural Coatings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1999) Architectural Wood Flush Doors
WDMA I.S. 4	(1994) Water-Repellent Preservative Non-Pressure Treatment for Millwork

1.2 SUBMITTALS

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

SD-03 Product Data

Doors; G(LEED)
Accessories
Preservative Treatment (LEED)
Adhesives (LEED)

Finishes (LEED)
Water-resistant sealer (LEED)
Sample warranty

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project. Documentation indicting reltive dollar value of rapidly renewable materials to total dollar value of products included in project. Highlight amount of VOC content and indicate FSC-certified wood products. Submit documentation verifying that no urea-formaldehyde resins were used. Comply with LEED credit requirements.

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

SD-07 Certificates

Forest Stewardship Council (FSC) Certification (LEED)

SD-11 Closeout Submittals

Water-resistant sealer (LEED)
Preservation Treatment (LEED)
Finishes (LEED)
Doors (LEED)

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

LEED documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Certified Wood (LEED)

LEED documentation relative to certified wood credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

1.5 SUSTANABLE DESIGN REQUIREMENTS

1.5.1 Certified Wood

Wood products shall be FSC-certified in accordance with LEED credit requirements. See Section 01 33 29 LEED DOCUMENTATION for cumulative total certified wood requirements.

1.5.2 Forest Stewardship Council (FSC) Certification

USe FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated.

2.1.1 Flush Doors

Conform to WDMA I.S. 1-A for flush doors. Provide solid core doors.

2.1.1.1 Interior Flush Doors

Provide staved lumber core, Type II flush doors conforming to WDMA I.S. 1-A with faces of sound grade hardwood or hardboard for stain finish.

2.1.2 Acoustical Doors

WDMA I.S. 1-A, solid core, constructed to provide Sound Transmission Class rating of 45 when tested in accordance with ASTM E 90.

2.2 ACCESSORIES

2.2.1 Door Louvers

Fabricate from metal and of sizes indicated. Provide louvers with a minimum of 35 percent free air. Equip louvers with slat type.

2.2.2 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers.

2.3 FABRICATION

2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating

quality and construction of the door.

2.3.2 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations including exterior doors with a water-repellent preservative treatment and so marketed at the manufacturer's plant in accordance with WDMA I.S. 4. Wood doors and frames shall be dip-treated with waterborne boron solution.

2.3.3 Adhesives and Bonds

WDMA I.S. 1-A. Use Type I bond for exterior doors and Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.4 Prefitting

Provide factory prefinished and factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.3.5 Finishes

2.3.5.1 Field Staining

Field stain as indicated. Comply with SCAQMD Rule 1113, in accordance with the LEED Reference Guide credit requirements for low-emitting materials.

2.3.6 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finishes. Comply with low-emitting materials requirements of GS-36, in accordance with the LEED Reference Guide.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed1/4 inch when measured in accordance with WDMA I.S. 1-A.

-- End of Section --

SECTION 08 33 23

OVERHEAD COILING DOORS
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 within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures

ASME INTERNATIONAL (ASME)

ASME B29.400	(2001; R 2008) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2010) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 53/A 53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(2010) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications

ASTM E 330	(2002; R 2010) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2006) Enclosures
NEMA MG 1	(2009) Motors and Generators
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code
NFPA 80	(2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2010) Building Materials Directory

1.2 DESCRIPTION

Overhead coiling doors to be counterbalanced doors by methods of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members. Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated.

Fire-rated door assemblies must bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for the rating listed on the drawings. Provide a permanent label for each door showing the manufacturer's name and address and the model/serial number of the door.

Oversized fire-rated door assemblies must be provided with a listing agency oversize label, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure of at least 20 pounds per square foot with a maximum deflection of 1/120 of the opening width. Provide test data showing compliance with ASTM E 330. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested Complete assembly must meet or exceed the requirements of ASCE/SEI 7-05.

1.3.2 Fire-Rated Doors, Frames, and Hardware

Provide fire-rated doors, frames, and hardware which are tested, rated, and labeled in accordance with Underwriters Laboratories, Factory Mutual or Warnock Hersey. The labels must indicate the rating in hours, per NFPA 80 of duration of exposure to fire, with a letter following the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed face of the door at the end of 30 minutes of fire exposure.

Provide and attach metal UL labels to each item of hardware in accordance with requirements specified in the UL Bld Mat Dir.

1.3.3 Oversized Coiling Fire-rated Door Assemblies

Where fire-rated doors and frames exceed the size for which testing and labeling services are offered, furnish certificates of inspection from the UL, Factory Mutual or Warnock Hersey. State within certificates that except for size; doors, frames, and hardware are identical in design, materials, and construction to a door that has been tested and rated.

1.3.4 Operational Cycle Life

All portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue must be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

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

Provide fabrication drawings that show complete assembly with hardware and framing details for the following items:

Overhead Coiling Doors
Counterbalancing Mechanism
Manual Door Operators
Electric Door Operators
Bottom Bar
Guides
Mounting Brackets

Overhead Drum
Hood
Painting

Submit Installation Drawings in accordance with paragraph entitled, "Overhead Coiling Door Assemblies," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items listing all accessories including supports, locks and latches, and weather stripping.

Overhead Coiling Doors
Hardware
Counterbalancing Mechanism
Manual Door Operators
Electric Door Operators
Fire-Rated Door Assembly

SD-05 Design Data

Submit equipment and performance data for the following items in accordance with the paragraph entitled, "Performance Requirements," of this section.

Overhead Coiling Doors
Hardware
Counterbalancing Mechanism
Manual Door Operators
Electric Door Operators
Fire-Rated Door

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Materials
Devices
Procedures
Manufacture's Brochures
Parts Lists
Cleaning

1.5 OVERHEAD COILING DOOR DETAIL SHOP DRAWINGS

Provide installation drawings for overhead coiling door assemblies which show elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, and details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Show locations of replaceable fusible links wiring diagrams for power, signal and controls. Include a schedule showing the location of each door with the drawings.

Contractor must submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days

prior to contract completion.

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Provide test data that is legible and of good quality.

1.6 WARRANTY, OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

- Materials
- Devices
- Electric Door Operators
- Hood
- Counterbalancing Mechanism
- Painting
- Procedures
- Manufacture's Brochures
- Parts Lists

Contractor must furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship and that they will remain so for not less than two years after completion and acceptance of the project.

Contractor must warrant that upon notification by the Government, he will immediately make good any defects in material, workmanship, and door operation within the same time period covered by the guarantee, at no cost to the Government.

1.7 DELIVERY AND STORAGE

Delivered doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 OVERHEAD COILING DOORS

2.1.1 Curtain Materials and Construction

Provide curtain slats which are fabricated from aluminum sheets conforming to ASTM B 209 (ASTM B 209M) sheet or ASTM B 221 (ASTM B 221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch and as required to meet requirements.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Provide slats which are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely

within slat faces on interior surface of slats.

2.1.2 Locks

Provide end and/or wind locks of cast steel conforming to ASTM A 27/A 27M, Grade B; galvanized in accordance with ASTM A 653/A 653M, ASTM A 153/A 153M and ASTM A 924/A 924M and secured at every other curtain slat.

2.1.3 Weather Stripping

Weather-stripping at the door-head and jamb must be 1/8-inch thick sheet of natural or neoprene rubber with air baffles, secured to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Threshold weather-stripping must be 1/8-inch thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D 2000.

2.1.4 Locking Devices

Slide Bolt to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Locking Device Assembly which includes cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.1.5 Safety Interlock

Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.1.6 Overhead Drum

Fabricate drums from nominal 0.040-inch thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finish for type of use and finish indicated.

2.2 HARDWARE

All hardware must conform to ASTM A 153/A 153M, ASTM A 307, ASTM F 568M, and ASTM A 27/A 27M.

2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for track adjustment.

2.2.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's standard steel shapes and plates conforming to ASTM A 36/A 36M, galvanized in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M. Size the shapes

and plates in accordance with the industry standards for the size, weight, and type of door installation.

2.3 COUNTERBALANCING MECHANISM

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.3.1 Brackets

Provide the manufacturer's standard mounting brackets of either cast iron or cold-rolled steel with one located at each end of the counterbalance barrel conforming to ASTM A 48/A 48M.

2.3.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A 53/A 53M, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 inch per foot of span under full load.

2.3.3 Spring Balance

One or more oil-tempered, heat-treated steel helical torsion springs installed within the barrel capable of producing sufficient torque to assure easy operation of the door curtain. Provide and size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

2.3.4 Torsion Rod for Counter Balance

Fabricate rod from the manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

2.4 ELECTRIC DOOR OPERATORS

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70.

Electric door-operator assemblies must be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Assemblies must be complete with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes, clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. rrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use will not affect the adjustment of the limit switches. Provide an electrical or mechanical

device which will automatically disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.4.1 Door-Operator Types

Provide an operator which is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position and produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding thehorsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified.

2.4.3 Motor Bearings

Bearings must be bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 1/2 horsepower.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the motor with instructions for lubrication cycle maintenance.

2.4.4 Motor Starters, Controls, and Enclosures

Each door motor must have a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 120-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Control equipment must conform to NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for general purpose NEMA Type 1. Oil-tight and dust-tight NEMA Type 13.

2.4.6 Transformer

Provide starters with 230/460 to 115 volt control transformers with one secondary fuse when it is required to reduce the voltage on control circuits to 120 volts or less. Provide transformer that conforms to NEMA ST 1.

2.4.7 Safety-Edge Device

Provide each door with a pneumatic safety device extending the full width of the door and located within a U-section neoprene or rubber astragal mounted on the bottom rail of the bottom door section. Device must immediately stop and reverse the door upon contact with an obstruction in the door opening during downward travel and cause the door to return to full-open position. Safety device is not a substitute for a limit switch.

Connect safety device to the control circuit through a retracting safety cord and reel.

2.4.8 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies running in oil or grease and encased in a sealed casing, coupled to the motor through a flexible coupling. Drive shafts must rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units which are in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide bearings which are the antifriction type equipped with oil seals.

2.4.9 Chain Drives

Provide roller chains that are power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times the design load.

Roller-chain side bars, rollers, pins, and bushings must be heat-treated or otherwise hardened.

Provide chain sprockets that are high-carbon steel with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.4.10 Brakes

Provide brakes which are 360-degree shoe brakes or shoe and drum brakes, solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.4.11 Clutches

Clutches must be the 4-inch diameter, multiple face, externally adjustable friction type or adjustable centrifugal type.

2.5 FIRE-RATED DOOR ASSEMBLY

Provide fire-rated door assemblies with the dimensions, fire rating, and operating type indicated with electric operators and assemblies that do not interfere with manufacturer's standard interconnecting fusible links.

Provide door manufacturer's standard interconnecting fusible links for door assemblies on both sides of the wall opening.

2.5.1 Fire Ratings

Provide fire-rated door assemblies complying with NFPA 80 Standard for Fire Doors and Other Opening Protectives and UL Fire Resistance - Volume 3.

2.6 SURFACE FINISHING

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component 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 contrast.

PART 3 EXECUTION

3.1 GENERAL

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, doors must be free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 FIELD PAINTED FINISH

Roll up doors shall be powder coated aluminum finishes must be free of scratches or other blemishes. Steel frames which are to be field painted must accordance with Section 09 90 00 PAINTS AND COATINGS and manufacturer's written instructions. Protect weather stripping from paint. Finishes must be free of scratches or other blemishes.

3.3 ACCEPTANCE PROVISIONS

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test the door opening and closing operation when activated by controls or alarm-connected fire-release system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset door-closing mechanism after successful test.

Test and make final adjustment of new doors at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, the Contractor must examine, lubricate, test, and re-adjust doors as required for proper operation.

3.3.2 CLEANING

Clean aluminum doors in accordance with manufacturer's approved instructions.

-- End of Section --

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
11/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section and the work requirements:

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501	(2005) Methods of Test for Exterior Walls
AAMA 503	(1992) Voluntary Specification for Field Testing of Metal Store-Fronts, Curtain Walls, and Sloped Glazing Systems

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A156.10	(1999) Power Operated Pedestrian Doors
ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

ASTM INTERNATIONAL (ASTM)

ASTM B 221/B 221M	(2003) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E 1105	(2000) Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors, Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 783	(1993) Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA GM	(1997) Glazing Manual

INTERNATIONAL CODE COUNCIL (ICC)

SBCCI Chapter 12	(November 2001) Interior Environment

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

16 CFR PART 1201	(2001) Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 325	(2002) Door, Drapery, Gate, Louver, and Window Operators and Systems

1.2 SYSTEM DESCRIPTION

1.2.1 Entrance Performance Requirements

1.2.1.1 Air Infiltration

For single acting offset pivot, butt hung or continuous geared hinge entrances in the closed and locked position, the test specimen must be tested in accordance with ANSI A156.10 and ASTM E 283 at a pressure differential of 1.57 psf for pairs of doors. A pair of 6'0" x 8'0" entrance doors and frame must not exceed 1.2 cfm\ft2.

1.2.2 Structural

Test corner strength per manufacturer's dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity. Testing procedure and certified test results per AAMA 503, ASTM E 1105, ASTM E 783, ASTM E 331, SBCCI Chapter 12, and must be available upon request.

1.2.2.1 Uniform Load

A static air design load of 85 psf (65 psf for 9/16" laminated infill) must be applied in the positive and negative direction in accordance with AAMA 501 and ASTM E 330. There must be no deflection in excess of l/180 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage must occur.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

Quality Assurance/Control Submittals:

SD-02 Shop Drawings

Shop drawings; G

SD-06 Test Reports

Submit Certified Test Reports showing compliance with specified performance characteristics and UL 325.

SD-07 Certificates

Submit for Owner's acceptance, Manufacturer's Product Warranty; G for entrance system as follows:

Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty begins in no event later than six months from date of shipment by manufacturer. In addition, welded door corner construction must be supported with a limited lifetime warranty for the life of the door under normal use.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Installer Qualifications

Installer experienced (as determined by Subcontractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

1.4.1.2 Manufacturer Qualifications

Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method. Provide three copies of Manufacturer's Product Warranty and Certified Test Reports.

1.4.2 Pre-Installation Meetings

Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Ordering

Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

1.5.2 Packing, Shipping, Handling and Unloading

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1.5.3 Storage and Protection

Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum (Entrances and Components)

2.1.1.1 Material Standard

ASTM B 221/B 221M; 6063-T5 alloy and tempered.

Provide door stile and rail face dimensions of the entrance doors as indicated. See Section 08 11 16 ALUMINUM DOORS AND FRAMES.

2.1.1.2 Tolerances

Reference to tolerances for wall thickness and other cross-sectional dimensions of entrance members are nominal and in compliance with Aluminum Standards and Data, published by The Aluminum Association.

Glazing gaskets must be either EPDM elastomeric extrusions or a thermoplastic elastomer.

2.2 ACCESSORIES

2.2.1 Fasteners

Where exposed, must be stainless steel.

2.2.2 Perimeter Anchors

When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.2.3 Standard Entrance Hardware

2.2.3.1 Weatherstripping

Equip meeting stiles on pairs of doors with an adjustable astragal utilizing wool pile with polymeric fin.

The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) must be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.

Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners. (Necessary to meet specified performance tests.)

2.2.3.2 Threshold

Extruded aluminum, one piece per door opening, with ribbed surface.

2.2.3.3 Offset Pivots

Manufacturer standard top and bottom pivots with one intermediate offset pivot.

2.2.3.4 Panic Device

Provide manufacturer's standard panic hardware.

2.2.3.5 Closer

Surface closer only per ANSI/ BHMA A156.4.

2.2.3.6 Security Lock/Dead Lock

A/R MS 1850A lock with (2) A/R 1871 cylinder operated flush bolts.

2.2.3.7 Cylinder(s)/Thumb-turn

Manufacturer standard.

2.2.3.8 Cylinder Guard

Manufacturer standard.

2.3 RELATED MATERIALS

2.3.1 Sealants

Refer to Section 07 92 00 JOINT SEALANTS.

2.3.2 Glass

Clear, laminated glass per Section 08 81 00 GLAZING.

2.4 FABRICATION

2.4.1 Entrance System Fabrication

Contractor shall prepare shop drawings prior to fabrication. Door corner construction must consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" long fillet welds inside and outside of all four corners. Exterior glazing stop must be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord. Interior glazing stop must be mechanically fastened to the door member and it must incorporate a silicone compatible spacer used with silicone sealant.

Accurately fit and secure joints and corners. Make joints hairline in appearance.

Prepare components with internal reinforcement for door hardware.

Arrange fasteners and attachments to conceal from view. Refer Sections 08 11 16 ALUMINUM DOORS AND FRAMES and 08 51 13.00 40 ALUMINUM WINDOWS.

2.5 SOURCE QUALITY CONTROL

2.5.1 Source Quality

Provide aluminum entrances specified herein from a single source.

2.5.1.1 Building Enclosure System

When aluminum entrances are part of a building enclosure system, including

storefront framing, windows, curtain wall system and related products, provide building enclosure system products from a single source manufacturer.

2.5.2 Fabrication Tolerances

Fabricate aluminum entrances in accordance with entrance manufacturer's prescribed tolerances.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Site Verification of Conditions

Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

Verify openings are sized to receive storefront system and sill plate is level in accordance with manufacturer's acceptable tolerances.

3.1.2 Field Measurements

Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.2 INSTALLATION

Install entrance system in accordance with manufacturer's instructions and AAMA storefront and entrance guide specifications manual.

Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

Provide alignment attachments and shims to permanently fasten system to building structure.

Align assembly plumb and level, free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

Set thresholds in bed of mastic and secure.

3.2.1 Adjusting

Adjust operating hardware for smooth operation.

3.2.2 Related Products Installation Requirements

3.2.2.1 Sealants (Perimeter)

Refer to Section 07 92 00 JOINT SEALANTS.

3.2.2.2 Glass

Refer to Section 08 81 00 GLAZING.

3.2.2.3 Reference

ANSI Z97.1, 16 CFR PART 1201 and GANA GM.

3.3 PROTECTION AND CLEANING

3.3.1 Protection

Protect installed product's finish surfaces from damage during construction. Protect aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

3.3.2 Cleaning

Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

-- End of Section --

SECTION 08 44 00

INSULATED TRANSLUCENT FIBERGLASS WALL PANEL UNITS
04/08

PART 1 GENERAL

1.1 SUBMITTALS

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

SD-02 Shop Drawings

Shop Drawings; G

Include plans, elevations, sections, and details, indicating dimensions, tolerances, profiles, anchorage, connections, fasteners, provisions for expansion and contraction, drainage, flashing, finish, glazing, and attachments to other work.

SD-03 Product Data

Submit manufacturer's data sheets on each product to be used, including:

Installation methods
Maintenance instructions

SD-04 Samples

For each finish product and glazing material specified, submit one sample, minimum 12 inches wide, representing actual product and color(s).

SD-06 Test Reports

Submit certified test reports from a qualified independent testing agency, indicating skylights and wall systems comply with specified requirements, based on testing of current products. Submit results from the following tests:

Flame spread and smoke development, ASTM E 84. UL 723 Submit UL card
Burn extent, ASTM D 635
Color change, ASTM D 2244 in accordance with ASTM D 1436
Abrasion & Erosion Resistance, ASTM D 4060
Impact stregth, exterior face sheets, UL 972
Accelerated aging, ASTM D 1037
Bond tensile strength, ASTM C 297 after aging by ASTM D 1037
Bond shear strength, ASTM D1002
Beam bending strength, ASTM E 72
Insulating U-factor; G, NFRC 100, ASTM C 236
Self-ignition, ASTM D 1929
Class A burning brand, ASTM E 108
Air infiltration, ASTM E 283

Water penetration, ASTM E 331
Uniform load deflection, ASTM E 72 and ASTM E 330
Concentrated and Impact, Fall Through Resistance ASTM E 661
Certification authorization under the NFRC PCP (Framing and Panel)

SD-11 Closeout Submittals

WARRANTY; G

Documentation; (LEED)

LEED documentation relative to local/regional materials credit, recycled content credit, and rapidly renewable materials content, in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.2 QUALITY ASSURANCE

1.2.1 Manufacturer Qualifications

Manufacturer to have a minimum ten years documented experience in the fabrication of wall systems of the type required for this project and be capable of providing field service representation during installation.

1.2.2 Panel System

Panel system must be listed by the International Code Council Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an approved agency.

1.2.3 Single Source

Obtain each type of metal wall and liner panels, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.2.4 Performance Requirements

The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1.2.4.1 Panel System

Panel system shall have less than 0.01cfm/ft² air leakage by ASTM E 283 at 6.24 PSF 50 mph and no water penetration by ASTM E 331 at 20 psf before and after structural testing by ASTM E 330.

1.2.5 Installer Qualifications

Installer to have minimum five years documented experience in the work of this section who has specialized in the installation of work similar to that required for this project and is approved by the manufacturer.

1.2.6 Preinstallation Meeting

Convene a pre-installation meeting 2 weeks before start of installation of wall systems. Require attendance of parties directly affecting work of this section, including Contractor, Architect, installer, and manufacturer's

representative. Review requirements for preparation, installation, cleaning, protection, and coordination with other work.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, and location of installation.

1.3.2 Storage

Store products above the floor and under cover in a clean, dry area until ready for installation.

1.3.3 Handling

Protect materials and finish from damage during handling and installation.

1.4 SEQUENCING

a. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

b. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.5 PROJECT CONDITIONS

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.6 WARRANTY

The warranty period is to be no less than 2 years from the government acceptance of work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the translucent panel system shows evidence of excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the translucent panel system manufacturer. Walking on panel shall NOT void warranty.

PART 2 PRODUCTS

2.1 PANEL COMPONENTS

2.1.1 Face Sheets

2.1.1.1 Translucent Faces

Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.

a. Thermoplastic - Polycarbonate and acrylic faces are not acceptable.

b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.

2.1.1.2 Face Sheets

Face sheets shall not delaminate when exposed to 200°F for 30 minutes per IBC or 300°F for 25 minutes.

2.1.1.3 Interior Face Sheets

a. Flamespread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flamespread rating no greater than 50 and smoke developed no greater than 350 when tested in accordance with UL 723/ASTM E 84.

b. Burn extent by ASTM D 635 shall be no greater than 1 inch.

2.1.1.4 Exterior Face Sheets

a. Color Stability - Full Thickness of the exterior face sheet shall not change color more than 3.0 CIE Units Delta E by ASTM 2244 after 5 years outdoor South Florida weathering at 5 degrees facing south, determined by the average of at least five white samples. Color stability shall be unaffected by abrasion or scratching. ACCELERATED AGING TESTING IS NOT CONSIDERED EQUAL.

b. Erosion Resistance: Exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide long-term resistance to reinforcing fiber exposure. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D 4060 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles.

c. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 ft. lbs. without fracture or tear when impacted by a 3-1/4inch diameter, 5 lb. free-falling ball per UL 972.

2.1.1.5 Appearance

a. Exterior face sheets: Smooth, 0.070 inch thick and crystal in color.

b. Interior face sheets: Smooth, 0.045 inch thick and crystal in color.

c. Face sheets shall not vary more than +/- 10% in thickness and be uniform in color. Provide sample of face sheet color to Architect prior to bid for approval

2.1.2 Grid Core

2.1.2.1 Thermally Broken I-Beam Grid Core

Thermally broken I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and

perimeter. Width of I- beam shall be no less than 7/16 inch. The I-beam grid shall be machined to tolerances of not greater than +/- .002 inch.

2.1.2.2 I-Beam Thermal Break

Minimum 1 inch, thermoset. Urethane poured and de-bridged is not acceptable.

2.1.3 Laminate Adhesive

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council Acceptance Criteria for Sandwich Panel Adhesives.

2. Minimum tensile strength of 750 psi when the panel assembly is tested by ASTM C 297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D 1037.

3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to five (5) separate conditions:

a. 50% Relative Humidity at 68° F: 540 PSI
b. 182° F: 100 PSI
c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

2.2 PANEL CONSTRUCTION

1. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.

a. Exterior panel system shall be 4" insulated units unless otherwise noted.
b. Exterior 4" system minimum U-value is .08, maximum SHGC is .07, visible light transmission is 8%.
c. Exterior 2 3/4" system minimum U-value is .10, maximum SHGC is .13, visible light transmission is 10%.
d. Interior 2 3/4" system minimum U-value is .53 maximum SHGC is .65, visible light transmission is 50%.

2. Panels shall deflect no more than 1.9" at 30 psf in 10' 0 inch span without a supporting frame by ASTM E 72.

3. Panels shall withstand 1200°F fire for minimum one (1) hour without collapse or exterior flaming.

4. Thermally broken panels:

a. Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.

b. Minimum CRF of 90 at center of grid cell.

2.3 BATTENS AND PERIMETER CLOSURE SYSTEM

2.3.1 Closure System

Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.

1. Thermally broken perimeter system shall have a urethane bridge.

2.3.2 Sealing Tape

Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

2.3.3 Fasteners

300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

2.3.4 Finish

Exposed aluminum to be manufacturer's factory applied finish that meets the performance requirements of AAMA 2604.

1. Color to be custom color as selected by Architect.

2.4 OPERABLE GLAZING

2.4.1 General

Windows HC 2000 shall be designed specifically for inclusion in the translucent panel unit wall system and factory unitized to panels.

2.4.1 Performance

Windows shall pass or exceed requirements of AAMA/WDMA/CSA - 101/I.S.2/A440-05.

Prepare aluminum surfaces for painting in accordance with ASTM D 1730, Type B, Method 2 or 3.

2.4.2 Construction

All Window frame members shall be of heavy gauge 6060-T5 extruded aluminum with a thermal break. Frame sections shall be coped and joined by stainless steel screws at each corner. All joints exposed to the weather shall be sealed with an elastic compound. All openings shall be double weather-stripped using T-slot bulb gaskets to insure minimum air infiltration.

1. Operating sash shall be hollow extruded design, mitered and joined with heavy reinforcing corners.
2. Both operable and fixed lites shall be inside glazed with an expanded EPDM closed cell sponge gasket to the exterior, with aluminum glazing bead and a driven EPDM wedge gasket to the interior for rapid removal and replacement.

2.4.3 Hardware

1. Hinges on operating windows shall be 4 bar stainless steel with adjustable friction blocks.

2. Locking hardware shall be of cam lever design and shall be made of cast white bronze.

2.4.4 Glazing

Windows shall be glazed with 1", Low E, double-insulated glass and tinted film (Minimum SHGC of 0.235 and Maximum U-Value of 0.27).

2.4.5 Finish of Exposed Aluminum

Manufacturer's factory applied finish which meets the requirements of AAMA 2604. Color to be custom color as selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, supporting structure and installation conditions. Do not proceed with panel erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

3.2.1 Metal Protection

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3. Where aluminum will contact pressure treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

1. Install the panel system in accordance with the manufacturer's installation recommendations and approved shop drawings.

a. Anchor component parts securely in place by permanent mechanical attachment system.
b. Accommodate thermal and mechanical movements.
c. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

2. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

3.4 CLEANING

Clean the panel system inside and outside, immediately after installation,

according to manufacturer's written recommendations. Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

SECTION 08 81 00

GLAZING
02/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM C 1172	(2003) Standard Specification for Laminated Architectural Flat Glass
ASTM C 1184	(2005) Standard Specification for Structural Silicone Sealants
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(2005) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 395	(2003; R 2008) Standard Test Methods for Rubber Property - Compression Set
ASTM E 1300	(2007e1) Determining Load Resistance of Glass in Buildings
ASTM E 773	(2001) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Classification of the Durability of Sealed Insulating Glass Units

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual
GANA Sealant Manual	(1990) Sealant Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001	(1990) Guidelines for Sloped Glazing
IGMA TM-3000	(1997) Glazing Guidelines for Sealed Insulating Glass Units
IGMA TR-1200	(1983) Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2004) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-378	(Basic; Notice 1) Putty Linseed Oil Type, (for Wood-Sash-Glazing

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SUBMITTALS

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

SD-03 Product Data

Insulating Glass; G

Documentation for Energy Star qualifications.

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

Local/Regional Materials; G (LEED)

Sealants; G (LEED)

Submit manufacturer's product data, indicating VOC content.

SD-04 Samples

Insulating Glass; G

Two 8 x 10 inch samples of each of the following: low "E" glass and insulating glass units.

SD-07 Certificates

Insulating Glass

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

SD-08 Manufacturer's Instructions

Setting and sealing materials
Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

SD-11 Closeout Submittals

Local/Regional Materials; G (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Sealant (LEED)

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated

wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees Fand rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 SUSTANAIBLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, withing a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED (tm) DOCUMENTATION for cumulative total local material requirements. Glass and coatings may be locally available.

PART 2 PRODUCTS

2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.

Type I, Class 1 (clear), Quality q5 (B). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.1.2 Laminated Glass

ASTM C 1172, Kind LA fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C 1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 inch. Fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear 0.015 inch thick polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be clear.

2.2 INSULATING GLASS UNITS

Two panes of 1/4 inchglass separated by a dehydrated 1/2 inch gas cavity, filled with air, and hermetically sealed. Glazed systems (including frames) shall be Energy Star labeled products as appropriate to climate zone and as applicable to window type, with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of 0.19 determined according to NFRC 200 procedures. Glazed panels and curtain walls shall have a U-factor maximum of 0.29 Btu per square foot x hr x degree F in accordance with NFRC 100. Glazing shall meet or exceed a luminous efficacy of 1.0. Dimensional tolerances shall be as specified in IGMA TR-1200. The units shall meet CBA Grade requirement when tested in accordance with ASTM E 773 and ASTM E 774, Class A. Spacer shall be black, roll-formed, steel-reinforced butyl rubber with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass shall be coated to provide a maximum of 22% visual light transmittance and 31% reflectance. Coating color to be in accordance with Section 09 06 90 COLOR SCHEDULE.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty shall be linseed oil type conforming to CID A-A-378for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.3.2 Glazing Compound

ASTM C 669. Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.3.3 Sealants

Provide elastomeric and structural sealants. Comply with LEED low-emitting materials credit requirements for all interior sealants.

2.3.3.1 Elastomeric Sealant

ASTM C 920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant shall be white.

2.3.3.2 Structural Sealant

ASTM C 1184, Type S.

2.3.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.3.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D 2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C 509 and ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.3.8 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.3.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.3.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.3.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.3.9 Accessories

Provide as required for a complete installation, including glazing points,

clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.4 Installation of Heat-Absorbing Glass

Glass shall have clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.5 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside

to allow water drainage into the channel.

-- End of Section --

SECTION 09 06 90

COLOR SCHEDULE
05/09

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color", as used herein, includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, propose a color for approval.

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-04 Samples

Color Schedule; G

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors. Submit 3 sets of color boards, 120 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size 8-1/2 by 11 inch boards with a maximum spread of size 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

e. Color boards shall be submitted to the Contracting Officer

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

2.2.1.1 Mortar:

A. Angelus Block, "Champagne"
B. Angelus Block, "Slate"

2.2.1.2 Concrete Masonry Units:

A. Angelus Block, Burnished, "Champagne"
B. Angelus Block, Burnished, "Slate"

2.2.1.3 Corrugated Metal Wall Panels, Hardware, and Associated Trim:

PAC, CLAD "Champagne"

2.2.1.4 Glass and Glazing:

A. Insulated Translucent Wall Panels - Kalwall, "Crystal/Crystal"
B. Storefront System - Solarban R100, "Optiblue" coating
C. Glazing - Solarban R100, "Optiblue" coating

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

2.2.2.1 Steel Doors and Door Frames:

Painted to match color of "CMU B" (Angelus Block "Merlot")

2.2.2.2 Steel Windows (mullion, muntin, sash, trim, and sill):

Painted to match color of "CMU B" (Angelus Block "Merlot")

2.2.2.3 Aluminum Doors and Door Frames:

Clear Anodized

2.2.2.4 Aluminum Windows (mullion, muntin, sash, trim, and sill):

Clear Anodized

2.2.2.5 Fascia:

PAC-CLAD Flush Panels, "Champagne"

2.2.2.6 Soffits and Ceilings:

PAC-CLAD Flush Panels, "Champagne"

2.2.2.7 Overhangs: at curved roofs

PAC-CLAD Flush Panels, "Copper Penny"

2.2.2.8 Downspouts, Gutters, Louvers, and Flashings:

Painted to match adjacent surface color as closely as possible.

2.2.2.9 Coping:

PAC-CLAD, "Champagne"

2.2.2.10 Caulking and Sealants:

Clear, white, or gray to match adjacent surfaces as closely as possible.

2.2.2.11 Control Joints:

Clear, white, or gray to match adjacent surfaces as closely as possible.

2.2.2.12 Guardrails:

A. Steel posts, handrails, hardware: painted to match metal wall panels as closely as possible (PAC-CLAD "Champagne")
B. Cable rail: Stainless steel

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Provide roof color to match the colors listed below.

2.2.3.1 Metal:

PAC-CLAD "Copper Penny"

2.2.3.2 TPO:

White

2.2.3.3 Penetrations:

Shall match roof in color, as closely as possible.

2.2.4 Interior Floor Finishes

Provide flooring materials to match the colors listed below.

2.2.4.1 Carpet Tile:

Milliken Carpet, "Plan A" Collection, "P6676 Go To" Design, "311 Feather Color".

2.2.4.2 Linoleum Composition Tile:

Forbo Marmoleum Composition Tile (MCT), "MCT-713 Calico" (Field)

Forbo Marmoleum Composition Tile (MCT), "MCT-629 Eiger" (Accent)

2.2.4.3 Stair Risers:

Industrial gray

2.2.4.4 Ceramic Tile:

Dal Tile, "Almond"

2.2.4.5 Grout:

DAl Tile, "Almond"

2.2.4.6 Concrete Micro-Topping:

Provide color samples from manufacturer's standard colors for selection by the Contracting Officer's TEchnical Representative.

2.2.5 Interior Base Finishes

Provide base materials to match the colors listed below.

2.2.5.1 Resilient Base and Moldings:

Forbo, C94 "Dark Bisque"

2.2.5.2 Ceramic Tile:

Dal Tile, "Almond" (Field)
Dal Tile, "Atlantis" (Accent)

2.2.5.3 Grout:

Dal Tile, "Almond" (Field)
Dal Tile, "Atlantis" (Accent)

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Provide wall materials to match the colors listed below.

2.2.6.1 Paint:

Vista Paint, "Oat Cake"

2.2.6.2 Ceramic Tile:

Dal Tile, "Almond"

2.2.6.3 Ceramic Tile Grout:

Dal Tile, "Almond"

2.2.6.4 Metal Panels:

PAC-CLAD, "Champagne"

2.2.6.5 Glazed Units:

Insulated Translucent Wall Panels - Kalwall "Crystal/Crystal"

2.2.6.6 Columns:

To match metal wall panels (PAC-CLAD "Champagne")

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Provide ceiling materials to match the colors listed below.

2.2.7.1 Ceiling Tile and Grid:

A. Acostical Units: USG "Radar ClimaPlus", white
B. Curved Aluminum Units: USG "Metallic Oyster"

2.2.7.2 Paint:

Vista Paint "Oat Cake"

2.2.7.3 Metal Deck:

Painted to match curved aluminum ceiling units (USG "Metallic Oyster") as closely as possible.

2.2.7.4 Structural Framing:

Painted to match curved aluminum ceiling units (USG "Metallic Oyster") as closely as possible.

2.2.8 Interior Trim

Provide interior trim to match the colors listed below.

2.2.8.1 Steel Doors:

Industrial Gray, matte finish

2.2.8.2 Steel Door Frames:

Industrial Gray, to match steel doors

2.2.8.3 Aluminum Doors and Door Frames:

Clear Anodized

2.2.8.4 Aluminum Windows :

(mullion, muntin, sash, trim, and sill) clear anodized

2.2.8.5 Wood Stain:

Natural/clear finish

2.2.8.6 Fire Extinguisher Cabinets:

White

2.2.8.7 Handrails:

Gray

2.2.8.8 Ladders:

Pre-finished as per manufacturer's standard colors.

2.2.8.9 Metal Stairs:

Gray

2.2.8.10 Exposed Ductwork:

White

2.2.8.11 Benches and Lockers:

Bradley "Charcoal Gray"

2.2.9 Interior Miscellaneous

Provide miscellaneous items to match the colors listed below.

2.2.9.1 Toilet Partitions and Urinal Screens:

Bradley "Charcoal Gray"

2.2.9.2 Plastic Laminate:

Pionite "Slate"

2.2.9.3 Solid Surfacing Material:

Bradley Terreon RE "Oat"

2.2.9.4 Metal Casework:

Contractor to provide color samples for selection by Contracting Officer's Technical Representative.

2.2.9.5 Wall Switch Handles and Standard Receptacle Bodies:

Ivory

2.2.9.6 Electrical Device Cover Plates:

Ivory

2.2.9.7 Electrical Panels:

To match adjacent wall as closely as possible.

2.2.9.8 Shower Curtain:

Beige, mildew resistant

2.2.9.9 Shower Curtain Rod:

Stainless steel

2.3 PLACEMENT SCHEDULE

Placement of color shall be in accordance with the Finish Schedule: shown on the drawings

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 09 30 00

CERAMIC TILE
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 A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1026	(1987; R 2002) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1028	(2007) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 241/C 241M	(2009) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 373	(1988; R 2006) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	(2002; R 2009) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 2002) Relative Resistance to Wear

	of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(2004; R 2009) Breaking Strength of Ceramic Tile
ASTM C 847	(2009) Standard Specification for Metal Lath
ASTM D 226/D 226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4068	(2009) Chlorinated Polyethylene Sheeting for Concealed Water-Containment Membrane
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 446	(1985; R 2009) Grab Bars and Accessories Installed in the Bathing Area
MARBLE INSTITUTE OF AMERICA (MIA)	
MIA Design Manual	(2003) Dimension Stone Design Manual
TILE COUNCIL OF AMERICA (TCA)	
TCA Hdbk	(2007) Handbook for Ceramic Tile Installation
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.

1.2.2 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Tile materials may be locally available.

1.2.3 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: ceramic tile.

1.3 SUBMITTALS

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

SD-03 Product Data

Local/Regional Materials; G (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data; G
Tile; G (LEED)
Setting-Bed; G
Mortar, Grout, and Adhesive; (LEED); G

Manufacturer's catalog data and preprinted installation and cleaning instructions. Indicate VOC content.

Reinforcing Wire Fabric; (LEED)

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

SD-04 Samples

Tile; G
Accessories
Marble Thresholds
Grout; G

Samples of sufficient size to show color range, pattern, type and joints.

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in

accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Tile; (LEED)
Reinforcing Wire Fabric; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.7 EXTRA MATERIALS

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pound and for floor tile of 250 pound in accordance with ASTM C 648. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C 1026. Provide a 0.50 maximum percent water absorption in accordance with ASTM C 373. Provide a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Coordinate the color with Section 09 06 90 COLOR SCHEDULE. Tile shall contain a minimum of 15 percent post-consumer recycled content, or a minimum of 40 percent post-industrial recycled content, unless specified otherwise. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Tile may contain post-consumer and/or post-industrial recycled content.

2.1.1 Ceramic Tile

Furnish glazed ceramic tile and trim with the color extending uniformly across the body of the tile. Tile shall contain a minimum of 40 percent post-industrial recycled content. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C 501and bonding strength in accordance with ASTM C 482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors. Coordinate color with Section 09 06 90 COLOR SCHEDULE.

2.1.2 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

	Quantity	Location
a. Recessed soap holder and hand hold combination: support static load in compliance with ASTM F 446	6	showers

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33/C 33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150/C 150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Conform to ASTM C 847 for flat expanded type metal lath, and weighing a minimum 2.5 pound/square yard.

2.2.6 Reinforcing Wire Fabric

Conform to ASTM A 185/A 185M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire. Wire fabric shall be manufactured from a minimum of 80 percent recycled post-consumer waste and a minimum of 10 percent recycled post-industrial waste. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Wire fabric may contain post-consumer or post-industrial recycled content.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit and to the following for mortar, grout, adhesive, and sealant:

2.4.1 Dry-Set Portland Cement Mortar

TCA Hdbk. Zero-volatile organic compound (VOC) content.

2.4.2 Latex-Portland Cement Mortar

TCA Hdbk. Zero-VOC content.

2.4.3 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free. Maximum VOC content of 150 grams/liter.

2.4.4 Epoxy Resin Grout

TCA Hdbk. Prohibited unless specifically indicated otherwise.

2.4.5 Furan Resin Grout

TCA Hdbk and consist of an intimate mixture of furfuryl-alcohol resin with carbon filler and catalyst. Prohibited unless specifically indicated otherwise.

2.4.6 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Single-component polyurethane sealant shall have a zero-VOC content. Two-component polyurethane sealant shall have a maximum VOC content of 45 grams/liter.

2.5 MARBLE THRESHOLDS

Provide marble thresholds of size required by drawings or conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble with gray in color as approved by the Contracting Officer. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C 241/C 241M.

2.6 MEMBRANE MATERIALS

Conform to ASTM D 226/D 226M, Type 1 for 15 pound waterproofing membrane, asphalt-saturated building felt. Conform to ASTM D 4068 4 mil for polyethylene film.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of

TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCA Hdbk.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCA Hdbk for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Dry-set or Latex-Portland Cement to install tile in accordance with TCA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Organic Adhesive

Conform to TCA Hdbk for the organic adhesive installation of ceramic tile.

3.3.4 Furan Mortar and Grout

Conform to TCA Hdbk for furan mortar and grout installation.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbk. Install shower receptors in accordance with TCA Hdbk.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCA Hdbk for workable mortar bed materials and installation. Conform to TCA Hdbk for cured mortar bed

materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Dry-Set and Latex-Portland Cement

Use dry-set or Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.4.4 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Conform to the requirements of Section 07 12 00 BUILT-UP BITUMINOUS WATERPROOFING for waterproofing under concrete fill.

3.4.5 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum 2 inch, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCA Hdbk method.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Install thresholds where indicated, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile

abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

3.8 WASTE MANAGEMENT

Separate waste, including metal and cardboard, in accordance with the Waste Management Plan and recycle or reuse. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas and dispose of properly. Crush broken tile, offcuts smaller than a half tile, and excess mortar and grout for use as mosaic, sub-base, or fill. Institute recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

-- End of Section --

SECTION 09 51 00

CEILING 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.

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2009a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 641/A 641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635/C 635M	(2007) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636/C 636M	(2008) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 645	(2009a) Nonstructural Steel Framing Members
ASTM C 834	(2010) Latex Sealants
ASTM E 1264	(2008) Acoustical Ceiling Products
ASTM E 1414	(2006) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E 1477	(1998a; R 2008) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

ASTM E 580/E 580M	(2009a) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2005) Mounting Test Specimens During Sound Absorption Tests

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2010) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Provide CEILINGunits mechanically mounted on a suspension system. The unit size, texture, finish, and color must be as specified. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Submit complete design drawings for approval, showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan, and acoustical treatment.

1.2.1 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of 40 for when determined in accordance with ASTM E 1414. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.2.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C 423 Test Method. A sound-attenuating backer may be provided to achieve the specified NRC, provided it is in accordance with manufacturer's recommendations.

1.2.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.2.4 Other Submittals Requirements

The following shall be submitted:

a. Manufacturer's data indicating percentage of recycle material in acoustic ceiling tiles to verify affirmative procurement compliance.

b. Total weight and volume quantities of acoustic ceiling tiles with recycle material.

c. Manufacturer's catalog showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating for each required floor or roof construction and acoustic ceiling assembly.

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified fire endurance and sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

Certificate attesting that the mineral based acoustical units and the curved aluminum ceiling units furnished for the project contain recycled material and showing an estimated percent of such material.

1.2.4.1 LEED Submittal Requirements

The following documentation shall be submitted in accordance with LEED:

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project. Documentation relative to local/regional materials credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content

products to total dollar value of products included in project. Documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

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

Design Drawings; G

SD-03 Product Data

Ceiling Units; G
Certification (LEED); G
Suspension System; G

SD-04 Samples

Ceiling Units; G
Suspension System; G

SD-06 Test Reports

Ceiling Attenuation Class and Test; G

SD-07 Certificates

Ceiling Units

SD-11 Closeout Submittals

Documentation; (LEED)

LEED documentation relative to local/regional materials credit, recycled content credit, and rapidly renewable materials content, in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation. Acoustical units shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.7 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and tile work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace ceiling panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of suspension system.

1.9 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 CEILING UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Submit two samples of each type of ceiling unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E 1264, Class A, and the following requirements:

2.1.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

Product	Material	Percent of Post Consumer Materials	Percent of Total Recovered Materials
Laminate Paperboard	Post Consumer Paper	100	100
Rock Wool	Slag	75	
Cellulose	Post Consumer Paper	75	75

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. For informational purposes, a list of known sources for acoustical ceiling tiles using recycled material is provided in the EPA/CPG database at http://www.epa.gov/osw/conserve/tools/cpg/database.htm.

c. Note that the Contractor is not limited to these sources. A product meeting CPG recycle requirements from other sources may be submitted for the Government's approval.

d. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement and LEED requirements.

e. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Rapidly Renewable Content

Provide acoustical ceiling tiles that contain a minimum of 10% rapidly renewable materials. Submit documentation relative to rapidly renewable material credit, in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

2.1.3 Acoustical Units for Exposed-Grid System

a. Type: III (non-asbestos mineral fiber with painted finish).

b. Flame Spread: Class A, 25 or less

c. Pattern: CD.

d. Minimum NRC: 0.70 in all rooms and areas when tested on mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.84 or greater.

f. Nominal size: 24 by 24 by 3/4 inch.

g. Edge detail: Square.

h. Finish: Factory-applied standard finish.

i. Minimum CAC: 40.

j. Minimum recycled content: 58%

2.1.4 Metal Panels for Curved Grid System

a. Type: Perforated Painted Aluminum
b. Flame Spread: Class A, 25 or less
c. Pattern: Square perforations, 11% open area
d. Minimum NRC: 0.65, including sound-attenuating backer
e. Minimal Light Refletance Coefficient: LR-1, 0.75 or greater
f. Nominal Size: 2 feet by 6 feet
g. Finish: Factory-applied painted metal finish
h. Minimum CAC: 40
i. Minimum recycled content: 90%

2.1.5 Metal Panels for Concealed Suspension System

a. Type: Steel Soffit panels
b. Pattern: Flush (no reveal)
c. Material: hot-dipped ASTM A 653/A 653M, Grade A, galvanized, 24 gauge steel
d. Finish: Factory-applied polyvinylideneflouride (PVDF) coating over polyester primer.
e. Sheen: Gloss rating 25
f. Texture: Smooth
g. Nominal Size: 12 inch o.c. by 25 feet maximum by 1 inch
h. Minimum recycled content: 28%

2.2 SUSPENSION SYSTEM

2.2.1 Exposed-Grid Suspension

Provide standard exposed-grid suspension system conforming to ASTM C 635/C 635M for intermediate-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 15/16 inch. Provide mitered corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in UFC 3-310-04 and ASTM E 580/E 580M.

2.2.2 Curved Grid Suspension System

Provide standard curved grid suspension system conforming to ASTM C 635/C 635M for intermediate duty systems. Provide standard grid profile exposed to view of steel, with factory-applied finish to match panel units. Provide wall molding having a flange of not less than 15/16 inch. Provide a suspension system with a maximum deflection of 1/360 of the spen length. Conform seismic details to the guidance in UFC 3-310-04 and ASTM E 580/E 580M.

2.2.3 Concealed Suspension System

Provide standard ceiling furring suspension system conforming to ASTM C 645 for intermediate-duty systems. Provide concealed suspended furring members 16 inches o.c. attached to perpendicular channels at 48 inches o.c. ceiling shall have a maximum 1/8 inch edge gap at walls. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in UFC 3-310-04 and ASTMK E 580/E 580M.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A 641/A 641M, Class 1, 0.11 inch in diameter.

2.3.2 Straps

Provide straps of 1 by 3/16 inch galvanized steel conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 1008/A 1008M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.4 ADHESIVE

Use adhesive as recommended by tile manufacturer and complying with the requirements of SCAQMD Rule 1168.

2.5 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for ceiling units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.6 COLORS AND PATTERNS

Use colors and patterns for ceiling units and suspension system components as specified in Section 09 06 90 COLOR SCHEDULE, or on the drawing.

2.7 ACOUSTICAL SEALANT

Conform nonstaining acoustical sealant to ASTM C 834 and the requirements of SCAQMD Rule 1168.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached ceiling units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where ceiling units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and tile work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of ceiling installation. Provide ceiling work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C 636/C 636M, ASTM C 645 and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces as indicated. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each ceiling unit in semi-exposed or concealed systems.

3.1.3 Ceiling Units

Install ceiling units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of units are in close contact with metal supports, with each other, and in true alignment. Arrange ceiling units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or

improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING
02/09

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 4078	(2002; R 2008) Water Emulsion Floor Polish
ASTM D 5603	(2001; R 2008) Rubber Compounding Materials - Recycled Vulcanizate Particulate Rubber
ASTM E 648	(2009a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1482	(2004e1; R 2009) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1861	(2008) Resilient Wall Base
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 2169	(2002; R 2008) Resilient Stair Treads
ASTM F 2170	(2009) Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F 710	(2008) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

1.2.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available

from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local/regional material requirements. Flooring materials may be locally available.

1.2.2 Fire Resistance Requirements

Provide a minimum average critical radiant flux of 0.45 watts per square centimeter (Class I) for flooring in corridors and exits when tested in accordance with ASTM E 648.

1.2.3 Environmental Data

The following shall be submitted in accordance with LEED:

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Indicate type and amount of rapidly renewable material in product. Indicate relative dollar value of rapidly renewable content products to total dollar value of products included in project. Documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook. Indicate distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

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

Resilient Flooring and Accessories

Scaled drawings indicating patterns (including location of patterns and colors) and dimensions.

SD-03 Product Data

Resilient Flooring and Accessories; G (LEED)

Adhesives; G (LEED)

Manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Provide Material Safety Data Sheets (MSDS) for all primers and adhesives to the Contracting Officer. Highlight VOC emissions.

Linoleum Composition Tile;G (LEED)
Wall Base; G
Stair Treads, Risers and Stringers

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

LEED documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

LEED documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products and/or rapidly renewable materials content products relative to total dollar value of products included in project.

SD-04 Samples

Resilient Flooring and Accessories; G

Three samples of each indicated color and type of flooring, base, mouldings, and accessories. Provide a minimum 2-1/2 by 4 inch sample.

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G

Copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

Manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Local/Regional Materials (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Resilient Flooring and Accessories LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

LEED documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products and/or rapidly renewable materials content products relative to total dollar value of products included in project.

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces. Do not store near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 LINOLEUM COMPOSITION TILE

Conform to ASTM F 2195 and consist of homogeneous layer of a mixture of linoleum cement (binder in linoleum consisting of a mixture of linseed oil, pine rosin, fossil, or other resins or rosins, or an equivalent oxidized oleoresinous binder), cork and/or wood flour, mineral fillers, and pigments bonded to a polyester backing. Provide square tiles a minimun 13 inch square and overall thickness 0.080 inch minimum for linoleum tile. Tile shall comply with A.D.A recommended slip resistance of 0.6 for flat surfaces, and an impact sound reduction of 6dB. Tile shall contain a minimum of 65 percent rapidly renewable material. See Section 01 33 29 LEED DOCUMENTATION for cumulative total renewable resource requirements. Interior flooring material shall meet the requirements of LEED low-emitting materials credit, by being FloorScore certified.

2.2 WALL BASE

Conform to ASTM F 1861, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), Style A (straight - installed with carpet) and Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color. Product shall contain a minimum of 90 percent post-consumer recycled material. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Rubber sheet flooring may contain post-consumer or post-industrial recycled content.

2.3 STAIR TREADS, RISERS AND STRINGERS

Conform to ASTM F 2169, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber). Conform to ASTM F 2169 for surface of treads Class 2 raised diamond stud pattern. Provide square or round nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser. Rubber shall contain a minimum of 90 percent post-consumer recycled material and/or a minimum of 10 percent natural rubber, a rapidly renewable resource. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content and renewable resource requirements. Rubber may contain post-consumer or post-industrial recycled content and/or naturally renewable material.

2.4 MOULDING

Provide tapered mouldings of rubber and types as recommended by flooring manufacturer for both edges and transitions of flooring materials

specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.5 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Interior adhesives shall meet the requirements of LEED low emitting materials credit. VOC content shall be less than 50 grams/L.

2.6 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F 1482 for panel type underlayment products. Use one of the following substrates:

a. Concrete.

2.7 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D 4078 for polish.

2.8 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.9 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as per Section 09 06 90 COLOR SCHEDULE. Provide flooring in any one continuous area from same production run with same shade and pattern.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F 710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F 1482 for panel type underlayments. Before any work under this section is begun,

correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 or ASTM F 2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations.

3.4 PLACING LINOLEUM COMPOSITION TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.6 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.7 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover the surface of treads and risers the full width of the stairs. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths.

3.8 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, wash flooring with a nonalkaline cleaning solution, rinse thoroughly with clear cold water, and, except for rubber flooring and stair treads, risers and stringers, vinyl and other flooring not requiring polish finish by manufacturer, apply the number of coats of polish in accordance with manufacturer's written instructions. Clean and maintain all other flooring as recommended by the manufacturer.

3.9 WASTE MANAGEMENT

Separate offcuts and waste materials and reuse or recycle in accordance with the Waste Management Plan, keeping sheet materials larger than 2 square feet and tiles larger than 1/2 tiles separate for reuse. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and/or packaging material. Place materials defined as hazardous or toxic waste in designated containers and dispose of properly. Close and seal tightly partly used sealant and adhesive containers and store protected in a well ventilated fire-safe area at moderate temperature. See Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

3.10 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 68 00

CARPET
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.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 107	(2002) Colorfastness to Water
AATCC 16	(2004) Colorfastness to Light
AATCC 165	(1999) Colorfastness to Crocking: Textile Floor Coverings - AATCC Crockmeter Method
AATCC 174	(1998) Antimicrobial Activity Assessment of Carpets

ASTM INTERNATIONAL (ASTM)

ASTM D 3278	(1996; R 2004e1) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 5252	(2005) Operation of the Hexapod Drum Tester
ASTM D 5417	(2005) Operation of the Vettermann Drum Tester
ASTM D 5793	(2005) Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	(2005) Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 648	(2006a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Standard for Installation Specification of Commercial Carpet

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551	(1981) Machine-made Textile Floor

	Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition
NFPA 253	(2005) Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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

16 CFR 1630	Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered 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-03 Product Data

Carpet; G (LEED)
Carpet Pads; G (LEED)
Carpet Moldings
Base; G(LEED)

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's catalog data for the following items:

1) Carpet Pads
2) Carpet Moldings
3) Base

Surface Preparation
Installation

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements (LEED)

Three copies of report stating that carpet and carpet components contain recycled materials and/or involvement in a recycling or reuse program. Include in the report percentage of post-industrial and post-consumer recycled material and relative dollar value of recycled content products to total dollar value of products included in project. Include manufacturer's certification of compliance with Carpet and Rug Institute's Green Label Indoor Air Quality program

Environmental Data(LEED)

Documentation indicating type of bio based material in product and bio based content. Indicate relative dollar value of bio based content products to total dollar value of products included in project.

SD-04 Samples

Carpet; G

a. Carpet: Three "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Three pieces of each type at least 12 inches long.

c. Special Treatment Materials: Three samples showing system and installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements

Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material. Certificates, showing conformance with the referenced standards contained in this section, for the following:

1) Carpet Pads
2) Carpet Moldings

3) Base

SD-10 Operation and Maintenance Data

Carpet; G
Cleaning and Protection

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

Operational Service

Documentation of manufacturer's maintenance agreement or take-back program for carpet. Include 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.

SD-11 Closeout Submittals

Local/Regional Materials; G (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Carpet; (LEED)
Carpet Pads (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Carpet; (LEED)
Carpet Pads (LEED)

Adhesives and Concrete Primer; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 REGULATORY REQUIREMENTS

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Procure carpet in accordance with 40 CFR 247, and where possible,purchased locally to reduce emissions of fossil fuels from transporting.

Submit certificates, showing conformance with the referenced standards contained in this section, for the following: Carpet Pad and Moulding. Submit three copies of report stating that carpet and carpet components contain recycled materials and/or involvement in a recycling or reuse program. Include in the report percentage of post-industrial and

post-consumer recycled material and relative dollar value or recycled content products to total dollar value of products included in project. Include manufacturer's certification of compliance with Carpet and Rug Institute's Green Label Indoor Air uality program.

1.4 DELIVERY AND STORAGE

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues,and maintain at a temperature above 60 degrees F for 2 days prior to installation. Carpet or carpet tiles shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store carpet near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Carpet materials may be locally available.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: Carpet, Pad, & Adhesives.

1.7 SCHEDULING

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

1.9 OPERATIONAL SERVICE

Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

1.10 EXTRA MATERIAL

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of 5 percent of total square yards of each carpet type, pattern, and color.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Provide the Carpet and Rug Institute (CRI)Indoor Air Quality (IAQ) Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria. Carpet tiles shall have Carpet Component Identification Codes as established by the CRI for future recycling. The labels shall be permanently printed or attached to the carpet backing. The codes shall identify, at minimum, the carpet's face fiber, primary backing, and secondary backing. Carpet shall be PVC free. Provide color and pattern as per Section 09 06 90 COLOR SCHEDULE.

2.1.1 Polyester Carpet Face Fiber Recyclers

For informational purposes, a list of sources known to recycle polyester carpet face fibers is provided below. Note that the Contractor is not limited to these sources. An approved product from other sources may be submitted for the Government's approval during construction. Acceptable recyclers include, but are not limited to:

Bretlin, Inc.
LaFayette, Georgia

Central Vermont Carpet
Barre, Vermont

Environmental Building Supplies
Portland, Oregon

Image Industries
Amuchee, Georgia

Martin Color-FI
Edgefield, South Carolina

Talisman Mills, Inc.
Mequon, Wisconsin

2.1.2 Physical Characteristics

2.1.2.1 Modular Tile Carpet

Carpet shall comply with the following:

a. Carpet Construction: Tufted.

b. Type: Modular tile no less than 18 by 18 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

c. Pile Type: Textured Loop Pile.

d. Pile Fiber: Commercial 100 percent branded (federally registered trademark) nylon staple Type 6,6.

e. Gauge or Pitch: 1/8 per inch in accordance with ASTM D 5793.

f. Stitches or Rows/wires minimum 14 per inch.

g. Pile thickness 0.09 inch average.

h. Pile Density: 8,400.

i. Finished Pile Yarn Weight: Minimum 21 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D 5848.

j. Backing Materials: Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for glue down is needed. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet backing may contain post-consumer or post-industrial recycled content. Provide carpet backing with a minimum 15% post-industrial and minimum 10% post-consumer recycled content by weight.

2.2 PERFORMANCE REQUIREMENTS

a. ARR (Appearance Retention Rating): Test carpet with the minimum 3.0-3.5 (Heavy) ARR in accordance with either the ASTM D 5252(Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

b. Flammability and Critical Radiant Flux Requirements: Comply carpet with 16 CFR 1630. Provide carpet in corridors and exits with a minimum average critical radiant flux to meet minimum standards of NFPA 101 when tested in accordance with ASTM E 648.

c. Tuft Bind: Provide tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 10 pound average force for loop pile or 3 pound average force for cut pile.

d. Colorfastness to Crocking: Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

e. Colorfastness to Light: Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

f. Colorfastness to Water: Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

g. Delamination Strength: Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

h. Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

2.3 CARPET PADS

Provide a polyurethane foam cushion 64-ounce flame spread in accordance with NFPA 253.

2.3.1 Carpet Cushion

Provide carpet cushion made using a minimum of 85 percent recycled open-cell polyurethane foam. Carpet cushion shall be PVC free.

Collins & Aikman Floor Coverings
Dalton, Georgia

Chris Craft International Products
Waterford, New York

Carpenter Company
Richmond, Virginia

Dixie Manufacturing Corporation
Norfolk, Virginia

2.3.2 Recycling Requirements

Provide rubber carpet cushions with recycled tire rubber and be made from 60-90 percent of post consumer content and 60-90 percent or synthetic carpet cushions with recycled carpet fabrication scrap and be made from 100 percent of total recovered materials content.

2.4 CARPET MOLDINGS

Install carpet moldings, either vinyl or aluminum, where floor covering material changes or carpet edge does not abut a vertical surface.

2.5 BASE

Provide minimum overall thickness of base not less than 0.125 inch, color as selected from manufacturer's full line for approval from Contracting Officer. Cove style, 4 inch high. Furnish base in rolls not less than 96 feet long. Premold corners with wings not less than 2 inch long.

2.6 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Use peel and stick dry adhesive or wet adhesive with a maximum VOC content of 50 grams/liter in accordance with the LEED Reference Guide and lowemitting materials credit requirements. Provide waterproof, nonflammable, and nonstaining adhesives and concrete primers for carpet installation to meet local air-quality standards, and as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D 3278. An approved adhesive-free application method or product by the carpet manufacturer may be submitted for the Government's approval.

2.7 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in installation. Any seam sealant shall have a maximum VOC content of 50 grams/liter in accordance with the LEED Reference Guide. Do not use sealants that contain 1,1,1-trichloroethane or toluene. Comply with LEED low-emitting materials credit requirements.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab shall for moisture content and excessive alkalinity in accordance with CRI 104.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting shall until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with instructions of the carpet manufacturer. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by installers who are CFI certified (International Certified Floor covering Installer Association), or manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Mothproofing for wool carpets shall use autofoam mothproofing system. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation.

3.4.1 Modular Tile Installation

Install modular tiles with release adhesive and snugly jointed together, or in accordance with manufacturer's installation instructions. Lay tiles in a monolithic pattern with accessibility to the subfloor where required.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

3.6 REMNANTS

Collect information from manufacturer about maintenance agreement or take-back program options, and provide to Contracting Officer. Manage waste as specified in the Waste Management Plan. Non-retained scraps shall be set aside and returned to manufacturer for recycling into new product.

-- End of Section --

SECTION 10 21 13

TOILET COMPARTMENTS
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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A385/A385M	(2009) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SYSTEM DESCRIPTION

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS and Affirmative Procurement guidelines. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions with Fabrication Drawings for review.

1.2.1 Sustainable Design Requirements

1.2.1.1 Local/Regional Materials Documentation

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Toilet partition materials may be locally available.

1.2.1.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: Toilet compartment panels.

1.2.2 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

a. Type 2: High Density Polyethylene (HDPE).

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

Fabrication Drawings
Installation Drawings; G

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings for metal partitions and urinal screens. Installtion drawings as specified.

SD-03 Product Data

Toilet Partition System; G (LEED)
Cleaning and Maintenance Instructions
Color and Finishes
Galvanized Steel Sheet
Sound Deadening Cores
Partition Panels and Doors
Anchoring Devices and Fasteners
Hardware and Fittings
Brackets
Door Hardware
Floor-Anchored Partitions
Overhead-Braced Partitions

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

Local/Regional Materials (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Toilet Enclosure (LEED)
Urinal Screens (LEED)

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

SD-04 Samples

Colors and Finishes; G

Manufacturer's standard color charts and color samples.

Partition Panels

Three samples showing a finished edge on two adjacent sides and core construction, each not less than 12-inch square.

Hardware and Fittings
Anchoring Devices and Fasteners

Three samples of each item. Approved hardware samples may be installed in the work if properly identified.

SD-07 Certificates

Certification

Documentation of product quality, as specified.

SD-10 Operation and Maintenance Data

Waste Management Plan
Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

SD-11 Closeout Submittals

Local/Regional Materials Documentation; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Toilet Enclosures; (LEED)
Urinal Screens; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 REGULATORY REQUIREMENTS

Conform to ICC/ANSI A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.6 WARRANTY

Provide certification or warranties that metal toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than 5 years after completion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.1.2 Brackets

Wall brackets shall be two-ear panel brackets, T-style, 1-inch stock. Provide stirrup style panel-to-pilaster brackets.

2.1.3 Hardware and Fittings

2.1.3.1 General Requirements

Conform hardware for the toilet partition system to CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply latching devices and hinges for handicap compartments with 36 CFR 1191; provide stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

a. Corrossion-resistant steel shall conform to ASTM A 167, Type 304..

2.1.3.2 Finishes

a. Corrosion-resistant steel shall have a No. 4 finish.

b. Exposed fasteners shall match the hardware and fittings.

2.1.4 Door Hardware

2.1.4.1 Hinges

Hinges shall be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide self-lubricating hinges with the indicated swing. Hinges shall be the surface-mounted type. have the following type of return movement:

a. Torsion-rod return movement

2.1.4.2 Latch and Pull

Latch and pull shall be a combination rubber-faced door strike and keeper equipped with emergency access.

2.1.4.3 Coat Hooks

Coat hooks shall be combination units with hooks and rubber tipped pins.

2.2 PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 1 inch thick with face sheets not less than 0.0396 inch thick.

2.2.1 Toilet Enclosures

Conform toilet enclosures to CID A-A-60003, Type I, Style A, floor supported and C, overhead braced. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels shall be solid high-density polyethylene, Finish 5; water resistant; graffiti resistant; non-absorbent. Enclosures shall contain a minimum of 100 percent post-consumer and/or post-industrial recycled plastic. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. This item may contain post-consumer or post-industrial recycled content. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending

stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

2.2.2 Urinal Screens

Conform urinal screens to CID A-A-60003, Type III, Style A, floor supported. Provide finish for surface of screens as solid high-density polyethylene, Finish 5; water resistant; graffiti resistant; non-absorbent; with plastic face sheets permanently fused to plastic core; 1/4 inch radius beveled edges. Screens shall contain a minimum of 100 percent post-consumer and/or post industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Furnish width and height of urinal screens as shown. Provide thickness of 1 inch. Secure wall hung urinal screens with 42 inch long, continuous flanges. Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant steel fittings and fasteners.

2.3 FLOOR-ANCHORED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Trim piece at the floor shall be 3 inch high and fabricated from not less than 0.030 inch thick corrosion-resistant steel.

2.4 OVERHEAD-BRACED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0393 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 0.0635 inch thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 3/16 inch bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 1 inch wide by 1-1/2 inch high, 0.125-inch wall thickness. Finish shall be AA-C22A31 in accordance with AA DAF-45. Set and secure brace into the top of each pilaster. Fabricate 3 inch high trim piece at the floor from not less than 0.030 inch thick corrosion-resistant steel.

2.5 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Pilaster shoes shall be aluminum or stainless steel. Shoes shall contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Pilaster shoes may contain post-consumer or post-industrial recycled content. Height shall be 3 inches.

2.6 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware shall be pre-drilled by manufacturer. Hardware finish shall be highly resistant to alkalis, urine, and other common toilet room acids. Latching devices and hinges for

handicap compartments shall comply with 36 CFR 1191 and shall be HDPE or stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Screws and bolts shall be stainless steel, tamper proof type. Wall mounting brackets shall be continuous, full height, corrossion-resistant stainless steel, in accordance with toilet compartment manufacturer's instructions. Floor-mounted anchorage shall consist of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.

2.7 COLORS AND FINISHES

2.7.1 Colors

Coordinate color of finishes for toilet partition system components with Section 09 06 90 COLOR SCHEDULE. Color of pilaster shoes shall match the core of solid plastic compartments and screens.

2.7.2 Finishes No.4 and No. 5

Provide solid plastic fabricated of polymer resins (polyethylene) formed under high pressure rendering a single component section not less than one inch thick. Colors shall extend throughout the panel thickness. Provide exposed finish surfaces: smooth, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Solid plastic partitions shall not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 80 degrees F for a minimum of 30 days:

a.	Acetic Acid (80 percent)	Hydrochloric Acid (40 percent)
b.	Acetone	Hydrogen Peroxide (30 percent)
c.	Ammonia (liquid)	Isopropyl Alcohol
d.	Ammonia Phosphate	Lactic Acid (25 percent)
e.	Bleach (12 percent)	Lime Sulfur
f.	Borax	Nicotine
g.	Brine	Potassium Bromide
h.	Caustic Soda	Soaps
i.	Chlorine Water	Sodium Bicarbonate
j.	Citric Acid	Trisodium Phosphate
k.	Copper Chloride	Urea; Urine
l.	Core Oils	Vinegar

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than

1/2 inch and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inch. Expansion shields shall have a load-carrying strength of not less than 600 pounds per anchor.

d. Submit Installation Drawings for metal toilet partitions and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.3 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields shall have a minimum 2-inch penetration into the concrete slab.

3.4 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields shall have a minimum 2-inch penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.

3.5 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched.

3.6 CLEANING

Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

3.7 WASTE MANAGEMENT PLAN

Identify manufacturer's policy for collection or return of construction scrap, unused material and packaging material. Institute demolition and construction waste separation and recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials. See Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

-- End of Section --

SECTION 10 51 13

PLASTIC LOCKERS
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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2003; Errata 2007) Accessible and Usable Buildings and Facilities

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design (tm) Green Building Rating System for New Construction (LEED-NC)

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

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SYSTEM DESCRIPTION

Provide a complete and usable locker storage system, including doors, frames, hooks, hardware, and support components. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS and Affirmative Procurement guidelines. Furnish the lockers from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit manufacturer's Cleaning and Maintenance Instructions for review.

1.2.1 Sustainable Design Requirements

1.2.1.1 Local/Regional Materials Documentation

Use materials or products extracted, harvested, or removed, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED (tm) DOCUMENTATION for cumulative total local material requirements. Locker

materials may be locally available.

1.2.1.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: Solid Plastic Lockers.

1.2.2 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

a. High Density Polyethylene (HDPE)

1.3 SUBMITTALS

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

SD-03 Product Data

Cleaning and Maintenance Instructions
Material
Handles
Locker Components
Assembly instructions
Environmental Data
Lockers; (LEED); G

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

Local/Regional Materials; (LEED) G

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

SD-04 Samples

Colors and Finishes; G

Provide a minimum of three samples, each not less than 3 inch square, of each color indicated.

SD-07 Certificates

Warranty

SD-10 Operation and Maintenance

Plastic Identification

SD-11 Closeout Submittals

Local/Regional Materials Documentation; (LEED)
Lockers; (LEED)

Comply with LEED credit requirements and include in LEED Documentation Notebook.

1.4 REGULATORY REQUIREMENTS

Conform to ICC/ANSI A117.1 code for access for the handicapped operation of lockers and hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver lockers and associated materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.6 WARRANTY

Provide certification or warranties that solid plastic lockers will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than 20 years after completion, under normal use.

1.7 PERFORMANCE CHARACTERISTICS

Government may request performance-characteristic tests on assembled lockers. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 LOCKERS

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.Lockers shall contain a minimum of 100 percent post-consumer and post-industrial content. See Section 01 33 29 LEED (tm) DOCUMENTATION for cumulative total recycled content requirements.

2.1.1 Double-Tier Lockers

Double-tier lockers must be as follows:

Type DTC-1: Double-tier locker 12 inches wide, 18 inches deep, and 72 inches high, attached to a 6-inch high closed base set back 3 inches from locker front to provide toe clearance.

2.2 MATERIAL

2.2.1 High Density Polyethylene (HDPE)

Lockers shall be constructed of High Density Polyethylene (HDPE) with homogeneous color and a matte finish texture.

2.2.2 Colors and Finishes

Provide manufacturer's standard color charts for color of finishes for locker system components.

Colors shall extend throughout the panel thickness. Provide exposed finish surfaces: matte finish texture, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Coordinate color with Section 09 06 90 COLOR SCHEDULES.

2.3 LOCKER COMPONENTS

2.3.1 Built-In Locks

Provide locking devices as a padlock eye in the door latching mechanism constructed of 12 gauge stainless steel.

2.3.2 Coat Hooks

Double hook, black polycarbonate, secure with stainless steel screws.

2.3.3 Door Handles

36 CFR 1191. Constructed of molded plastic, color to match locker, ADA compliant operation of less than 5 lbs. of force.

2.3.4 Doors

Not less than 1/2 inch thick High Density Polyethylene (HDPE), matte finish texture, with ventilation slots.

2.3.4.1 Hinges

Heavy-duty, full-length piano hinge, 16 gauge type 304 stainless steel, powder coated to match locker color. Wrap hinge around edges of door and frame and secure with stainless steel security torx-head screws.

2.3.4.2 Latching Mechanisms

Full-length latch bar, 1/2 inch thick High Density Polyethylene (HDPE), matte finish texture, secured with stainless steel security torx-head screws.

2.3.5 Back and Side Panels, Tops, and Bottoms

Not less than3/8 inch thick High Density Polyethylene (HDPE), smooth finish, continuously formed with fused corners and welded to frames without metal fasteners or dovetail joints.

2.3.6 Sloping Locker Tops

Provide sloping locker tops continuous in length at 10 degrees slope. Provide 1 inch thick High Density Polyethylene (HDPE)with homogeneous color to match locker and a matte finish texture. Secure with concealed fasteners.

2.3.7 Base Panels

Not less than 1 inch thick High Density Polyethylene (HDPE) with

homegeneous color to match locker and matte finish texture, 6 inches tall, set back 3 inches from locker front for toe clearance. Base shall not be constructed of wood.

2.3.8 Legs

Provide lockers without legs, as indicated.

2.3.9 Number Plates

Aluminum. Provide consecutive numbers.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's assembly instructions. Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Secure adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively with odd numbers on top and even numbers on bottom.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 12 36 00

COUNTERTOPS
05/09

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

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

ASTM INTERNATIONAL (ASTM)

ASTM A 325M	(2009a) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM E 84	(2009c) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 836M	(2002) Standard Specification for Style 1 Stainless Steel Metric Nuts

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1	(2000) Performance & Construction Standards for Kitchen and Vanity Cabinets

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION (SEFA)

SEFA 7	(1996) Recommended Practice for Laboratory and Hospital Service Fittings

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-B-588	(Rev E) Bolt, Toggle: and Expansion Sleeve, Screw
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS TT-C-520	(Rev B; Am 1) Coating Compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles)
FS WW-P-541	(1990e; Am 1) Plumbing Fixtures

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

Submit fabrication drawings for Countertop and Backsplash Fabrication; G, specified in this section.

Installation drawings

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Solid Surface Countertops and Backsplashes; G (LEED)
Adhesives; G (LEED)
Service Fixtures
Accessories and Hardware

SD-04 Samples

Include samples for the following:

Countertop; G and Backsplash,; G one each, 4 inches in width, submitted as one unit or as separate items.

Accessories and Hardware, one each.

Submit Manufacturer's Standard Color Charts in accordance with paragraph entitled, "General," of this section.

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for in accordance with paragraph entitled, "General," of this section.

SD-11 Closeout Submittal

Local/Regional Materials (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Solid Surface Countertops and Backsplashes (LEED)
Service Fixtures (LEED)
Accessories and Hardware (LEED)

LEED documentation relative to recycled content and rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives (LEED)
Sealants (LEED)

LEED documentation relative to low emitting material credit in accordance with LEED Reference Guide. Highlight VOC content and include in LEED Documentation Notebook.

1.3 SYSTEM DESCRIPTION

1.3.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED (tm) DOCUMENTATION for cumulative total/regional material requirements.

1.3.2 Environmental Data

The following shall be submitted in accordance with LEED

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit shall be in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Indicate type and amount of rapidly renewable material in product. Indicate relative dollar value of rapidly renewable content products to total dollar value of products included in project. Documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook. Indicate distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3.3 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle countertops and backsplash in a manner that will prevent damage and disfigurement.

1.5 DESIGN

Provide factory fabricated, prefinished densified solid surface countertops in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Construct countertops as specified and meet the requirements of KCMA A161.1. Accomplish fastenings to permit removal and replacement of individual units without affecting the remainder of the installation. Provide counters with watertight sink rim when indicated. Include removable drawers equipped with position stops to avoid accidental complete withdrawals.

PART 2 PRODUCTS

2.1 GENERAL

Submit Manufacturer's Standard Color Charts for countertops showing the manufacturer's recommended color and finish selections. Coordinate with Section 09 06 90 COLOR SCHEDULE.

Submit Manufacturer's Instructions for countertops including special provisions required to install equipment components and system packages. Include all special notices detailing impedances, hazards and safety precautions.

Provide the manufacturer's standard type countertops or as indicated on the drawings. Accomplish fastenings to permit removal and replacement of individual countertops without affecting the remainder of the installation.

2.2 MATERIALS

Provide fasteners conforming to the following:

Screws: ASME B18.6.1, Group, Type and Class as applicable

Anchoring Devices: FS FF-S-325, Group, Type, and Class as applicable

Toggle bolts: FS FF-B-588, Type I, Class A, Style 2

Nuts: ASTM F 836M, corrosion-resistant steel

Bolts: ASTM A 325M, heavy, hexagon head bolts corrosion-resistant steel

Corrosion-resistant Steel Sinks:

18-gage corrosion-resistant steel, nonintegral, self-rimming

Drain holes in center of bowl

Underside coated with 1/8-inch thick sound deadener

Die-form, seamless, raised edges at front and ends

Cove corners to 1/2-inch radius

Equip with strainers and tail pieces

Sound deadening: conform to FS TT-C-520.

Provide Service Fixtures conforming to the following requirements:

Fixtures: In accordance with the water conservation policy as stated in the Standard Plumbing Codes, Appendix J.

Faucets: Splashback mounted, cast brass, chrome plated, FS WW-P-541

Faucets: Deck mounted, cast brass, chrome plated, FS WW-P-541

Gas, air, and vacuum, distilled water, steam, and de-ionized water cocks: Cast brass, chrome plated, ground key type

Drains, strainers, and taps: Brass, chrome plated, FS WW-P-541

Index buttons: Plastic, color codes in accordance with SEFA 7

Special items: Nipples and locknuts with each fixture will be as directed.

2.3 COUNTERTOP AND BACKSPLASH FABRICATION

Construct countertops and backsplash of Synthetic resin Z124.3, Z124.6, and ANSI/CPA SS-1-2001.

2.3.1 Solid Surface Countertops and Backsplashes

Construct countertop and backsplash as shown. Use material of 3/4 inch thickness minimum, cast, and filled nonporous solid surfacing composed of polyester resin crushed marble, glass frit, mineral fillers and pigments. Material is to comply with ANSI Z124.3 and ANSI Z124.6; Flammability: Class I, flame spread of 25 maximum, smoke developed of 100 maximum when tested in accordance with ASTM E 84; shall contain 25% preconsumer recycled content and 8% rapidly renewable material. See Section 01 33 29 LEED (tm) DOCUMENTATION for cumulative total of recycled and rapidly renewable material.

Where indicated, lavatories shall be integrated seamlessly with countertops, as fabricated by the manufacturer, and be constructed of the same materials and color.

2.4 SURFACING

2.5 ACCESSORIES AND HARDWARE

2.5.1 Mounting Adhesives

Provide structural-grade silicone or epoxy adhesives of type recommended by

manufacturer for application and conditions of use. Adhesives shall meet the requirements of low-emitting materials credit.

Provide spacers, if required, of type recommended by adhesive manufacturer.

2.5.2 Joint Sealants

Use clear silicone sealant of type recommended by manufacturer for application and conditions of use. Sealants shall meet the requirements of low-emitting materials credit.

2.5.3 Solvent

Use a product recommended by adhesive manufacturer to clean surface of quartz surfacing to assure adhesion of adhesives and sealants.

2.5.4 Cleaning Agents

Use non-abrasive, soft-scrub type kitchen cleaners, as recommended by Solid Surfacing manufacturer..

2.6 COLOR, TEXTURE, AND PATTERN

Select color from manufacturers standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers. Coordinate with Section 09 06 90 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Inspect material for defects prior to installation. Ensure materials throughout bear labels with the same batch number. Visually inspect materials used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on the project. Repair or replace damaged materials in a satisfactory manner.

Install countertops plumb with cabinetry level to within 1/16 inch in 10 feet. Level base cabinets by adjusting leveling screws. Scribe and fit scribe strips to irregularities of adjacent surfaces. Gap openings exceeding 0.025 inch are not acceptable.

Submit installation drawings for countertops. Drawings must include location of cabinets, details of cabinets related and dimensional positions, and locations for roughing in plumbing, including sinks, faucets, strainers and cocks.

3.1.1 Preliminary Installation and Adjustment

Install materials in accordance to manufacturer's recommendations. Lift and place to avoid breakage.

Position materials to verify that materials are correctly sized and prepared. Make necessary adjustments.

If jobsite cutting, grinding, or polishing is required, use water-cooled tools. Protect jobsite and surfaces against dust and water. Perform work away from installation site if possible.

3.1.2 Permanent Installation

After verifying fit, remove solid surfacing from position, clean substrates of dust and contamination, and clean solid surfacing back side and joints with solvent.

Apply sufficient quantity of mounting adhesive in accordance with adhesive manufacturer's recommendations to provide permanent, secure installation.

3.2 CLEANING

On completion of cabinet installation, touch up marred or abraded finished surfaces. Remove crating and packing materials from premises. Wipe down surfaces to remove fingerprints and markings and leave in clean condition.

3.3 INSPECTION

Examine casework grounds and supports for adequate anchorage, foreign material, moisture, and unevenness that could prevent quality casework installation.

Ensure that electrical and plumbing rough-ins for casework are complete. Do not proceed with installation until defects are corrected.

-- End of Section --

SECTION 12 48 13.13

ENTRANCE FLOOR MATS
05/09

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 182/A 182M	(2009a) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193/A 193M	(2009) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2009) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 666	(2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM B 221	(2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM D 2047	(2004) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM E 648	(2009a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 150	(2006) Electrical Resistance of

	Conductive and Static Dissipative Resilient Flooring
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2009) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

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

Entrance Mats; G (LEED)

Submit Manufacturer's Data and indicate percentage of recycled material content; by weight in protective flooring materials. Submit total weight and volume quantities of protective flooring materials with recycle materials content. Verify affirmative procurement compliance as required.

Adhesive; G (LEED)

Submit manufacturers product data, indicating VOC content.

SD-04 Samples

Submit one sample 12 inch square, assembled sections of floor mat to show corners, intersections, and other details of construction.

SD-11 Closeout Submittals

Local/Regional Materials (LEED)

LEED documentation relative to local/regional materials credit in accordance LEED Reference Guide. Include in LEED Documentation Notebook.

Entrance Mats (LEED)

LEED documentation relative to recycled content credit in accordance LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives (LEED)

Leed documentation relative to low-emitting materials creditin accordance LEED Reference Guide. Include in LEED Documentation Notebook.

1.2.1 Other Submittal Requirements

The following shall be submitted in accordance with LEED:

a. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project. Documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

b. Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project. Documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

c. Aluminum based products:

d. Documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 QUALITY ASSURANCE

Comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG) for installed entrance and floor mats.

Submit documentation of testing and compliance with the following standards:

a. Stainless Steel products: ASTM A 167,ASTM A 182/A 182M, ASTM A 193/A 193M, ASTM A 194/A 194M, ASTM A 666

b. Aluminum based products: ASTM B 221

c. Other materials: ASTM C 501, ASTM D 2047, ASTM D 2240, ASTM E 648, ASTM F 150, ASTM F 1869.

PART 2 PRODUCTS

2.1 AFFIRMATIVE PROCUREMENT

The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work. These items, when incorporated into the work under this contract, are to contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided, per 40 CFR 247.

Mats are listed in the EPA's Comprehensive Procurement Guidelines (CPG) at http://www.epa.gov/epaoswer/non-hw/procure/products/mats.htm.

EPA's recommended Recovered Materials Content Levels for Mats containing recovered rubber and/or plastic are as follows:

Product	Material	Percent Of Post Consumer Materials	Percent Of Total Recovered Materials
Mats	Rubber	75 - 100	85 - 100
	Plastic	10 - 100	100
	Rubber/ Plastic composite	100	100

The recommended recovered materials content levels are based on the dry weight of the raw materials, exclusive of any additives such as adhesives, binders, or coloring agents. EPA's recommendation does not preclude procuring agencies from purchasing mats manufactured from another material. It simply recommends that procuring agencies, when purchasing mats made from rubber or plastic, purchase these items made from recovered materials.

For informational purposes, a list of known sources for mats using recycled material is provided in the EPA/CPG Supplier database at http://www.ergweb2.com/cpg4review/user/cpg_search.cfm.

Note that the Contractor is not limited to these sources. A product meeting CPG recycle requirements from other sources may be submitted for the Government's approval.

Submit recycled material content data, calculated by weight, for protective flooring materials indicate compliance with affirmative procurement, where applicable.

Submit total weight and volume quantities of protective flooring materials with recycle material.

2.2 TYPE OF MATS

2.2.1 Entrance Mats

Furnish the following type of entrance mat system :

2.2.1.1 Stainless Steel Entrance Floor Mats/Grids

a. Module: 18 inch wide x 18 inch long x 3/4 inch tall. Provide factory-cut modules for irregular perimeter tiles.

b. Module Top Surface Inserts: T-304 stainless steel alloy, mill finish. Surface pattern shall consist of 0.090 inch thick stainless steel bars with 0.145 inch gaps, arranged to provide a minimum effective open area of 57.5% for fall-through potential of dirt and other contaminants. Flush, removable and interchangeable for periodic field cleaning and maintenance. Surface finish shall have a minimum Static Coefficient of Friction Slip Resistance (Wet) of 0.82.

c. Loading: All flooring modules shall be able to support a minimum rolling

load of 500 lbs. Ensure that the grate pattern and support bars of the module top surface inserts are electronically resistance-welded or tack welded to comply with required weight bearing properties.

d. Structural Assembly: All modules shall be framed with a stainless steel perimeter band, minimum 0.090 inch thickness, to provide structural support and stability. All assemblies shall include horizontal drain features such as perforations or slots to allow for dirt and water collection.

e. Collection Reservoir: Aluminum mud plate with integral polyethylene bond breaker (vapor barrier), for the collection of all contaminates from foot traffic. Attach to floor substrate with manufacturer's recommended adhesive.

f. Adhesive: Low-VOC flooring epoxy in accordance with SCAQMD Rule 1168, as per manufacturer's recommendations.

PART 3 EXECUTION

3.1 DELIVERY OF MATERIALS

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and place mats at indicated location.

Remove and dispose all excess packing materials.

3.2 EXAMINATION

Comply with manufacture's requirements of substrates and floor conditions for location, sizes, and other conditions affecting installation of floor mats and frames.

3.3 INSTALLATION

Install only in satisfactory conditions. Comply with manufacturer's written printed instructions for recessed mat frames. Apply flooring epoxy. Coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between doors and mat. Confirm all modules are flush and tight against one another, with a maximum gap of 1/16 inch at the perimeter. Do not allow space for grout, as per manufacturer's instructions.

3.4 Cleaning

Immediately upon completion of installation of entrance mat system in a room or an area, dry and/or clean the entrance mat system and adjacent surfaces to remove all surplus adhesive and debris. Periodic maintenance and cleaning of the entrance mat system shall be in accordance with manufacturer's printed maintenance instructions.

-- End of Section --

SECTION 23 09 23.13 20

BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC
08/09

PART 1 GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

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

ASHRAE 135	(2008; Addenda q Errata 2009, Addenda l, o, r, s, v 2009; Addenda j Errata 2010; Addenda h, k, n, t, u, w, x, y 2010; Errata 2010) BACnet—A Data Communication Protocol for Building Automation and Control Networks

ARCNET TRADE ASSOCIATION (ATA)

ATA 878.1	(1999) Local Area Network: Token Bus

ASME INTERNATIONAL (ASME)

ASME B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.1	(2007; Addenda a 2008; Addenda b 2009) Power Piping
ASME B40.100	(2005) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO/IEC 8802-3	(2000) Information Technology - Telecommunications and Information Exchange Between Systems - Local and

	Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD)Access Method and Physical Layer Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; TIA 08-1) National Electrical Code
NFPA 72	(2010; TIA 10-1; TIA 10-2; TIA 10-3; TIA 10-4) National Fire Alarm and Signaling Code
NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems

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

SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

UNDERWRITERS LABORATORIES (UL)

UL 508A	(2001; R thru 2010) Industrial Control Panels
UL 916	(2007; R 2009) Standard for Energy Management Equipment

1.2 DEFINITIONS

1.2.1 ANSI/ASHRAE Standard 135

ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks, referred to as "BACnet". ASHRAE developed BACnet to provide a method for diverse building automation devices to communicate and share data over a network.

1.2.2 ARCNET

ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it's possible to determine the maximum delay before a device is able to transmit a message.

1.2.3 BACnet

Building Automation and Control Network; the common name for the communication standard ASHRAE 135. The standard defines methods and protocol for cooperating building automation devices to communicate over a variety of LAN technologies.

1.2.4 BACnet/IP

An extension of BACnet, Annex J, defines this mechanism using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same

BACnet network number. See also "BACnet Broadcast Management Device".

1.2.5 BACnet Internetwork

Two or more BACnet networks, possibly using different LAN technologies, connected with routers. In a BACnet internetwork, there exists only one message path between devices.

1.2.6 BACnet Network

One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.

1.2.7 BACnet Segment

One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.

1.2.8 BBMD

BACnet Broadcast Management Device (BBMD). A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Every IP subnetwork that is part of a BACnet/IP network must have only one BBMD. See also "BACnet/IP".

1.2.9 BAS

Building Automation Systems, including DDC (Direct Digital Controls) used for facility automation and energy management.

1.2.10 BAS Owner

The regional or local user responsible for managing all aspects of the BAS operation, including: network connections, workstation management, submittal review, technical support, control parameters, and daily operation.

1.2.11 BIBBs

BACnet Interoperability Building Blocks. A collection of BACnet services used to describe supported tasks. BIBBs are often described in terms of "A" (client) and "B" (server) devices. The “A” device uses data provided by the "B" device, or requests an action from the “B” device.

1.2.12 BI

BACnet International, formerly two organizations: the BACnet Manufacturers Association (BMA) and the BACnet Interest Group - North America (BIG-NA).

1.2.13 BI/BTL

BACnet International/BACnet Testing Laboratories (Formerly BMA/BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

1.2.14 Bridge

Network hardware that connects two or more network (or BACnet internetwork)

segments at the physical and data link layers. A bridge may also filter messages.

1.2.15 Broadcast

A message sent to all devices on a network segment.

1.2.16 Device

Any control system component, usually a digital controller, that contains a BACnet Device Object and uses BACnet to communicate with other devices. See also "Digital Controller".

1.2.17 Device Object

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

1.2.18 Device Profile

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE Standard 135-2004, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing BIBBs supported.

1.2.19 Digital Controller

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions. In most cases, synonymous with a BACnet device described in this specification. See also "Device".

1.2.20 Direct Digital Control (DDC)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.2.21 DDC System

A network of digital controllers, communication architecture, and user interfaces. A DDC system may include programming, sensors, actuators, switches, relays, factory controls, operator workstations, and various other devices, components, and attributes.

1.2.22 Ethernet

A family of local-area-network technologies providing high-speed networking features over various media.

1.2.23 Firmware

Software programmed into read only memory (ROM), flash memory, electrically

erasable programmable read only memory (EEPROM), or erasable programmable read only memory (EPROM) chips.

1.2.24 Gateway

Communication hardware connecting two or more different protocols, similar to human language translators. The Gateway translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.

1.2.25 Half Router

A device that participates as one partner in a BACnet point-to-point (PTP) connection. Two half-routers in an active PTP connection combine to form a single router.

1.2.26 Hub

A common connection point for devices on a network.

1.2.27 Internet Protocol (IP, TCP/IP, UDP/IP)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.2.28 Input/Output (I/O)

Physical inputs and outputs to and from a device, although the term sometimes describes software, or "virtual" I/O. See also "Points".

1.2.29 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller.

1.2.30 IP subnet

Internet protocol (IP) identifies individual devices with a 32-bit number divided into four groups from 0 to 255. Devices are often grouped and share some portion of this number. For example, one device has IP address 209.185.47.68 and another device has IP address 209.185.47.82. These two devices share Class C subnet 209.185.47.00

1.2.31 Local-Area Network (LAN)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.2.32 LonTalk

ANSI/EIA 709. A communication protocol developed by Echelon Corp. LonTalk is an optional physical and data link layer for BACnet.

1.2.33 MAC Address

Media Access Control address. The physical node address that identifies a device on a Local Area Network.

1.2.34 Master-Slave/Token-Passing (MS/TP)

ISO/IEC 8802-3. One of the LAN options for BACnet. MSTP uses twisted-pair wiring for relatively low speed and low cost communication (up to 4,000 ft at 76.8K bps).

1.2.35 Native BACnet Device

A device that uses BACnet as its primary, if not only, method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.

1.2.36 Network

Communication technology for data communications. BACnet approved network types are BACnet over Internet Protocol (IP), Point to Point (PTP) Ethernet, ARCNET, MS/TP, and LonTalk®.

1.2.37 Network Number

A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

1.2.38 Object

The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

1.2.39 Object Identifier

An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

1.2.40 Object Properties

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.2.41 Peer-to-Peer

Peer-to-peer refers to devices where any device can initiate and respond to communication with other devices.

1.2.42 Performance Verification Test (PVT)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.2.43 PID

Proportional, integral, and derivative control; three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.2.44 PICS

Protocol Implementation Conformance Statement (PICS), describing the BACnet capabilities of a device. See BACnet, Annex A for the standard format and content of a PICS statement.

1.2.45 Points

Physical and virtual inputs and outputs. See also "Input/Output".

1.2.46 PTP

Point-to-Point protocol connects individual BACnet devices or networks using serial connections like modem-to-modem links.

1.2.47 Repeater

A network component that connects two or more physical segments at the physical layer.

1.2.48 Router

A BACnet router is a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.

1.2.49 Stand-Alone Control

Refers to devices performing equipment-specific and small system control without communication to other devices or computers for physical I/O, excluding outside air and other common shared conditions. Devices are located near controlled equipment, with physical input and output points limited to 64 or less per device, except for complex individual equipment or systems. Failure of any single device will not cause other network devices to fail. BACnet "Smart" actuators (B-SA profile) and sensors (B-SS profile) communicating on a network with a parent device are exempt from stand-alone requirements.

1.3 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.4 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC DESCRIPTION

a. provide new BACnet DDC systems including associated equipment and accessories. All devices are accessible using a Web browser interface and communicate using ASHRAE 135 BACnet communications without the use of gateways, unless gateways are shown on the design drawings and specifically requested by the Government. Where gateways are allowed,

they must support ASHRAE 135, including all object properties and read-write services shown on Government approved interoperability schedules. Manufacturer's products, including design, materials, fabrication, assembly, inspection, and testing shall be in accordance with ASHRAE 135, ASME B31.1, and NFPA 70, except where indicated otherwise.

1.4.1 Design Requirements

1.4.1.1 Control System Drawings Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

1.4.1.2 List of I/O Points

Also known as a Point Schedule, provide for each input and output point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Binary Output (BO), Binary Input (BI)), point sensor range, point actuator range, point address, BACnet object, associated BIBBS (where applicable), and point connection terminal number. Typical schedules for multiple identical equipment are allowed unless otherwise requested in design or contract criteria.

1.4.1.3 Control System Components List

Provide a complete list of control system components installed on this project. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, and manufacturer part number. For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name, spring or non-spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.4.1.4 Control System Schematics

Provide control system schematics. Typical schematics for multiple identical equipment are allowed unless otherwise requested in design or contract criteria. Include the following:

a. Location of each input and output device

b. Flow diagram for each piece of HVAC equipment

c. Name or symbol for each control system component, such as V-1 for a valve

d. Setpoints, with differential or proportional band values

e. Written sequence of operation for the HVAC equipment

f. Valve and Damper Schedules, with normal (power fail) position

1.4.1.5 HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required electrical interlocks.

1.4.1.6 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and output device. Indicate how each device is wired and powered; showing typical connections at the digital controller and power supply. Show for all field connected devices such as control relays, motor starters, actuators, sensors, and transmitters.

1.4.1.7 Terminal Strip Diagrams

Provide a diagram of each terminal strip. Indicate the terminal strip location, termination numbers, and associated point names.

1.4.1.8 BACnet Communication Architecture Schematic

Provide a schematic showing the project's entire BACnet communication network, including addressing used for LANs, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

1.5 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

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

SD-02 Shop Drawings

Include the following in the project's control system drawing set:

Control system drawings title sheet; G
List of I/O Points; G
Control System Components List; G
Control system schematics; G
HVAC Equipment Electrical Ladder diagrams; G
Component wiring diagrams; G
Terminal strip diagrams; G
BACnet communication architecture schematic; G

SD-03 Product Data

Direct Digital Controllers; G

Include BACnet PICS for each controller/device type, including smart sensors (B-SS) and smart actuators (B-SA).

BACnet Gateways; G

Include BACnet and workstation display information; bi-directional communication ability; compliance with interoperability schedule; expansion capacity; handling of alarms, events, scheduling and trend data; and single device capability (not depending on multiple devices for exchanging information from either side of the gateway).

BACnet Protocol Analyzer; G

Include capability to store and report data traffic on BACnet networks, measure bandwidth usage, filter information, and identify BACnet devices.

DDC Software; G
BACnet Operator Workstation; G
BACnet Operator Workstation DDC Software; G
Include BACnet PICS for Operator Workstation software.

Notebook Computer; G
Sensors and Input Hardware; G
Output Hardware; G
Surge and transient protection; G
Indicators; G
Duct smoke detectors; G

SD-05 Design Data

Performance Verification Testing Plan; G
Pre-Performance Verification Testing Checklist; G

SD-06 Test Reports

Performance Verification Testing Report; G

SD-07 Certificates

Contractor's Qualifications; G

SD-09 Manufacturer's Field Reports

Pre-PVT Checklist; G

SD-10 Operation and Maintenance Data

Comply with requirements for data packages in Section 01 78 23 OPERATION AND MAINTENANCE DATA, except as supplemented and modified in this specification.

BACnet Direct Digital Control Systems, Data Package 4; G
Controls System Operators Manuals, Data Package 4; G

SD-11 Closeout Submittals

Training documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Standard Products

Provide material and equipment that are standard manufacturer's products currently in production and supported by a local service organization.

1.6.2 Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before and during installation according to manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6.3 Operating Environment

Protect components from humidity and temperature variation, dust, and contaminants. If components are stored before installation, keep them within the manufacturer's limits.

1.6.4 Finish of New Equipment

New equipment finishing shall be factory provided. Manufacturer's standard factory finishing shall be proven to withstand 125 hours in a salt-spray fog test. Equipment located outdoors shall be proven to withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be according to ASTM B 117, with acceptance criteria as follows: immediately after completion of the test, the finish shall show no signs of degradation or loss of adhesion beyond 0.125 inch on either side of the scratch mark.

1.6.5 Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing work.

1.6.6 Contractor's Qualifications

Submit documentation certifying the controls Contractor performing the work has completed at least three DDC systems installations of a similar design to this project, and programmed similar sequences of operation for at least two years.

1.6.7 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.6.8 Project Sequence

The control system work for this project shall proceed in the following order:

a. Submit and receive approval on the Shop Drawings, Product Data, and Certificates specified under the paragraph entitled "SUBMITTALS."

b. Perform the control system installation work, including all field

check-outs and tuning.

c. Provide support to TAB personnel as specified under the paragraph "TEST AND BALANCE SUPPORT."

d. Submit and receive approval of the Controls System Operators Manual specified under the paragraph "CONTROLS SYSTEM OPERATORS MANUALS."

e. Submit and receive approval of the Performance Verification Testing Plan and the Pre-PVT Checklist specified under the paragraph "PERFORMANCE VERIFICATION TESTING."

f. Perform the Performance Verification Testing.

g. Submit and receive approval on the PVT Report.

h. Submit and receive approval on the Training Documentation specified under the paragraph "INSTRUCTION TO GOVERNMENT PERSONNEL". Submit at least 30 days before training.

i. Deliver the final Controls System Operators Manuals.

j. Conduct the Phase I Training.

k. Conduct the Phase II Training.

l. Submit and receive approval of Closeout Submittals.

PART 2 PRODUCTS

2.1 DDC SYSTEM

a. Provide a networked DDC system for control in compliance with the latest revision of the ASHRAE 135 BACnet standard. System shall be Siemens Apogee native BACnet system, to match the existing NASA site standard. Include all programming, objects, and services required to meet the sequence of control. Provide BACnet communications between the DDC system and native BACnet devices furnished with HVAC equipment. Devices provided shall be certified in the BACnet Testing Laboratories (BTL) Product Listing.

b. Connect the new work to the existing BAS system or operator workstation manufactured by Siemens (Apogee Model Number 571.010, located in 4810 Engineer Control Room). The existing CPU/Monitor, printer, and other peripherals shall be used to form a single operator workstation. New system including interface to existing systems and equipment shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified. Existing software and firmware shall be modified as needed to accommodate the additional control points.

2.1.1 Direct Digital Controllers

Direct digital controllers shall be UL 916 rated.

2.1.1.1 I/O Point Limitation

The total number of I/O hardware points used by a single stand-alone digital controller, including I/O expansion units, shall not exceed 64, except for complex individual equipment or systems. Place I/O expansion units in the same cabinet as the digital controller.

2.1.1.2 Environmental Limits

Controllers shall be suitable for, or placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

2.1.1.3 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.4 Internal Clock

Provide internal clocks for all BACnet Building Controllers (B-BC) and BACnet Advanced Application Controllers (B-AAC) using BACnet time synchronization services. Automatically synchronize system clocks daily from an operator-designated controller. The system shall automatically adjust for daylight saving time.

2.1.1.5 Memory

Provide sufficient memory for each controller to support the required control, communication, trends, alarms, and messages. Protect programs residing in memory with EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply). The backup power source shall have capacity to maintain the memory during a 72-hour continuous power outage. Rechargeable power sources shall be constantly charged while the controller is operating under normal line power. Batteries shall be replaceable without soldering. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long.

2.1.1.6 Immunity to Power Fluctuations

Controllers shall operate at 90 percent to 110 percent nominal voltage rating.

2.1.1.7 Transformer

The controller power supply shall be fused or current limiting and rated at 125 percent power consumption.

2.1.1.8 Wiring Terminations

Use screw terminal wiring terminations for all field-installed controllers. Provide field-removable modular terminal strip or a termination card connected by a ribbon cable for all controllers other than terminal units.

2.1.1.9 Input and Output Interface

Provide hard-wired input and output interface for all controllers as follows:

a. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with sources up to 24 volts AC or DC for any duration shall cause no controller damage.

b. Binary Inputs: Binary inputs shall have a toggle switch and monitor on and off contacts from a "dry" remote device without external power, and external 5-24 VDC voltage inputs.

c. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and accumulate pulses at a resolution suitable to the application.

d. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 VDC), current (4-20 mA), or resistance (thermistor or RTD) signals.

e. Binary Outputs: Binary outputs shall have a toggle switch and send a pulsed 24 VDC low-voltage signal for modulation control, or provide a maintained open-closed position for on-off control. For HVAC equipment and plant controllers, provide for manual overrides, either with three-position (on-off-auto) override switches and status lights, or with an adjacent operator display and interface. Where appropriate, provide a method to select normally open or normally closed operation.

f. Analog Outputs: Analog outputs shall send modulating 0-10 VDC or 4-20 mA signals to control output devices.

g. Tri-State Outputs: Tri-State outputs shall provide three-point floating control of terminal unit electronic actuators.

2.1.1.10 Digital Controller BACnet Internetwork

Provide a BACnet internetwork with control products, communication media, connectors, repeaters, hubs, and routers. Provide intermediate gateways, only when requested by the Government and shown on the contract drawings, to connect existing non-BACnet devices to the BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE 135, BACnet. If a controller becomes non-responsive, the remaining controllers shall continue operating and not be affected by the failed controller.

2.1.1.11 Communications Ports

a. Direct-Connect Interface Ports: Provide at least one extra communication port at each local BACnet network for direct connecting a notebook computer or BACnet hand-held terminal so all network BACnet objects and properties may be viewed and edited by the operator.

b. Telecommunications Interface Port: Provide one telecommunication port per building, permitting remote communication via point-to-point (PTP) protocol over telephone lines.

2.1.1.12 Modems

Provide DSL modems where required for communication between the BACnet Operator Workstation (B-OWS) and the DDC system.

2.1.1.13 BACnet Gateways

Provide BACnet communication ports, whenever available as a plant equipment

OEM standard option, for DDC integration via a single communication cable. Typical BACnet controlled plant equipment includes, but is not limited to, boilers, chillers, and variable frequency motor drives.

The following minimum capabilities are required:

a. Gateways shall be able to read and view all readable object properties listed in the interoperability schedule on the non-BACnet network to the BACnet network and vice versa where applicable.

b. Gateways shall be able to write to all writeable object properties listed in the interoperability schedule on the non-BACnet network from the BACnet network and vice versa where applicable.

c. Gateways shall provide single-pass (only one protocol to BACnet without intermediary protocols) translation from the non-BACnet protocol to BACnet and vice versa.

d. Gateways shall meet the requirements of Data Sharing Read Property (DS-RP-B), Data Sharing Write Property (DS-WP-B), Device Management Dynamic Device Binding-B (DM-DDB-B), and Device Management Communication Control (DM-DCC-B) BIBBs, in accordance with ASHRAE 135.

e. Gateways shall include all hardware, software, software licenses, and configuration tools for operator-to-gateway communications. Provide backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.1.1.14 Digital Controller Cabinet

Provide each digital controller in a factory fabricated cabinet enclosure. Cabinets located indoors shall protect against dust and have a minimum NEMA 1 rating, except where indicated otherwise. Cabinets located outdoors or in damp environments shall protect against all outdoor conditions and have a minimum NEMA 4 rating. Outdoor control panels and controllers must be able to withstand extreme ambient conditions, without malfunction or failure, whether or not the controlled equipment is running. If necessary, provide a thermostatically controlled panel heater in freezing locations, and an internal ventilating fan in locations exposed to direct sunlight. Cabinets shall have a hinged lockable door and an offset removable metal back plate, except controllers integral with terminal units, like those mounted on VAV boxes. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock.

2.1.1.15 Main Power Switch and Receptacle

Provide each control cabinet with a main external power on/off switch located inside the cabinet. Also provide each cabinet with a separate 120 VAC duplex receptacle.

2.1.2 DDC Software

2.1.2.1 Programming

Provide programming to execute the sequence of operation indicated. Provide all programming and tools to configure and program all controllers. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation.

a. Graphic-based programming shall use a library of function blocks made from pre-programmed code designed for BAS control. Function blocks shall be assembled with interconnecting lines, depicting the control sequence in a flowchart. If providing a computer with device programming tools as part of the project, graphic programs shall be viewable in real time showing present values and logical results from each function block.

b. Menu-based programming shall be done by entering parameters, definitions, conditions, requirements, and constraints.

c. If providing a computer with device programming tools as part of the project, provide a means for detecting program errors and testing software strategies with a simulation tool. Simulation may be inherent within the programming software suite, or provided by physical controllers mounted in a NEMA 1 test enclosure. The test enclosure shall contain one dedicated controller of each type provided under this contract, complete with power supply and relevant accessories.

2.1.2.2 Parameter Modification

All writeable object properties, and all other programming parameters needed to comply with the project specification shall be adjustable for devices at any network level, including those accessible with web-browser communication, and regardless of programming methods used to create the applications.

2.1.2.3 Short Cycling Prevention

Provide setpoint differentials and minimum on/off times to prevent equipment short cycling.

2.1.2.4 Equipment Status Delay

Provide an adjustable delay from when equipment is commanded on or off and when the control program looks to the status input for confirmation.

2.1.2.5 Run Time Accumulation

Use the Elapsed Time Property to provide re-settable run time accumulation for each Binary Output Object connected to mechanical loads greater than 1 HP, electrical loads greater than 10 KW, or wherever else specified.

2.1.2.6 Timed Local Override

Provide an adjustable override time for each push of a timed local override button.

2.1.2.7 Time Synchronization

Provide time synchronization, including adjustments for leap years, daylight saving time, and operator time adjustments.

2.1.2.8 Scheduling

Provide operating schedules as indicated, with equipment assigned to groups. Changing the schedule of a group shall change the operating schedule of all equipment in the group. Groups shall be capable of operator creation, modification, and deletion. Provide capability to view and modify

schedules in a seven-day week format. Provide capability to enter holiday and override schedules one full year at a time.

2.1.2.9 Object Property Override

Allow writeable object property values to accept overrides to any valid value. Where specified or required for the sequence of control, the Out_Of_Service property of Objects shall be modifiable using BACnet's write property service. When documented, exceptions to these requirement are allowed for life, machine, and process safeties.

2.1.2.10 Alarms and Events

Alarms and events shall be capable of having programmed time delays and high-low limits. When a computer workstation or web server is connected to the BACnet internetwork, alarms/events shall report to the computer, printer, e-mail, as defined by an authorized operator. Otherwise alarms/events shall be stored within a device on the BACnet network until connected to a user interface device and retrieved. Provide alarms/events in agreement with the point schedule, sequence of operation, and the BAS Owner. At a minimum, provide programming to initiate alarms/events any time a piece of equipment fails to operate, a control point is outside normal range or condition shown on schedules, communication to a device is lost, a device has failed, or a controller has lost its memory.

2.1.2.11 Trending

Provide BACnet trend services capable of trending all object present values set points, and other parameters indicated for trending on project schedules. Trends may be associated into groups, and a trend report may be set up for each group. Trends are stored within a device on the BACnet network, with operator selectable trend intervals from 10 seconds up to 60 minutes. The minimum number of consecutive trend values stored at one time shall be 100 per variable. When trend memory is full, the most recent data shall overwrite the oldest data.

The operator workstation shall upload trends automatically upon reaching 3/4 of the device buffer limit (via Notification_Threshold property), by operator request, or by time schedule for archiving. Archived and real-time trend data shall be available for viewing numerically and graphically for at the workstation and connected notebook computers.

2.1.2.12 Device Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and device fault condition. The DDC system shall recognize and report a non-responsive controller.

2.1.2.13 Power Loss

Upon restoration of power, the DDC system shall perform an orderly restart and restoration of control.

2.1.3 BACnet Operator Workstation

The workstation shall be capable of accessing all DDC system devices and communicate using the BACnet protocol. The workstation shall be capable of displaying, modifying, creating, archiving, and deleting (as applicable): all points, objects, object properties, programming, alarms, trends,

messages, schedules, and reports.

2.1.3.1 BACnet Operator Workstation Hardware

Configure according to system manufacturer's specifications and conforming to BACnet Operator Workstation (B-OWS) device standards found in ASHRAE 135, Annex L. Install to permit complete monitoring and troubleshooting of the DDC system.

At a minimum the workstation hardware shall include: a desktop personal computer with Microsoft Windows XP or VISTA Professional operating system or equal, processor and RAM exceeding capability and speed required by operating system and application software, hard drive capacity exceeding software and yearly archive requirements, 16X internal DVD+/-R/RW/CD-RW drive with archive creator software, external 200 GB USB 2.0 hard drive and cable, 4 USB 2.0 ports, 10/100 network interface card, MS/TP card, 19-inch LCD monitor, internal V.92 modem, sound card with speakers, 101 character keyboard, optical mouse, USB Hub with four USB 2.0 ports and connecting cable, laser printer with USB port and cable, 3 matching toner cartridges 3 matching color and black ink cartridges, 120-volt 800 VA uninterruptible power supply with automatic voltage regulation and 4 minimum battery back-up outlets and 2 surge protected outlets, Microsoft Office bundled software. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide a manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner.

2.1.3.2 Password Protection

Provide at least five levels of password protection for operator interfaces. The lowest level only allow viewing graphics. The second level allows viewing graphics and changing space temperature setpoints. The third level allows the previous level's capability, plus changing operating schedules. The fourth level allows access to all functions except passwords. The highest level provides all administrator rights and allows full access to all programming, including setting new passwords and access levels. Provide the BAS Owner with the highest level password access. Provide automatic log out if no keyboard or mouse activity is detected after a user-defined time delay.

2.1.3.3 BACnet Operator Workstation DDC Software

Provide the workstation software with the manufacturer's installation CDs and licenses. Configure the software according to the DDC system manufacturer's specifications and in agreement with BACnet Operator Workstation (B-OWS) device standards found in ASHRAE 135, Annex L.

The workstation software shall permit complete monitoring, modification, and troubleshooting interface with the DDC system. The operator interface with the software shall be menu-driven with appropriate displays and menu commands to manipulate the DDC system's objects, point data, operating schedules, control routines, system configuration, trends, alarms, messages, graphics, and reports. Trends shall be capable of graphic display in real time, with variables plotted as functions of time. Each alarmed point shall be capable of displaying its alarm history, showing when it went into alarm, if and when it was acknowledged, and when it went out of alarm. The modification of DDC system parameters and object properties shall be accomplished with "fill in the blank" and/or "point and drag" methods. Modifications shall download to the appropriate controllers at the

operator's request.

2.1.3.4 Graphics Software

Provide web-based system graphics viewable on browsers compatible with MS Internet Explorer 6.X or greater using an industry-standard file format such as HTML, BMP, JPEG, or GIF.

Graphic displays shall have full-screen resolution when viewed on the workstation and notebook computers. Dynamic data on graphics pages shall refresh within 10 seconds using an Internet connection, or 30 seconds using a dial-up modem connection. Graphics viewing shall not require additional "plug-in" software like Java, Shockwave and Flash applications unless the software is readily available for free over the Internet.

The graphics shall show the present value and object name for each of the project's I/O points on at least one graphic page. Arrange point values and names on the graphic displays in their appropriate physical locations with respect to the floor plan or equipment graphic displayed. Graphics shall allow the operator to monitor current status, view zone and equipment summaries, use point-and-click navigation between graphic pages, and edit setpoints and parameters directly from the screens. Items in alarm shall be displayed using a different color or other obvious visual indicator. Provide graphics with the following:

a. Graphic Types: Provide at least one graphic display for each piece of HVAC equipment, building floor, and controlled zone. Indicate dynamic point values, operating statuses, alarm conditions, and control setpoints on each display. Provide summary pages where appropriate.

(1) Building Elevation: For buildings more than one story, provide an elevation view of the building with links to each of the building's floor plans. Simulate the building's architecture and include the building number and floor numbers. If possible, use an actual photograph of the building.

(2) Building Floor Plans: Provide a floor plan graphic for each of the building's floors and roof with dynamic display of space temperature and other important data. If used, indicate and provide links to sub-plan areas. If possible, use the project's electronic drawing files for the graphic backgrounds. Provide clear names for important areas, such as "Main Conference Room." Include room names and numbers where applicable. Include features such as stairwells, elevators, and main entrances. Where applicable, include the mechanical room, HVAC equipment, and control component locations, with corresponding links to the equipment graphics.

(3) Sub-plan Areas: Where a building's floor plan is too large to adequately display on the screen, sub-divide the plan into distinct areas, and provide a separate graphic display for each area. Provide same level of detail requested in building floor plan section above.

(4) HVAC Equipment: Provide a graphic display for each piece of HVAC equipment, such as a fan coil unit, or air handling unit. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as a central chiller plant or central heating plant,

provide one graphic to depict the entire plant. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, dampers, and control valves. Show the direction of air and water flow. Include dynamic display of applicable object data with clear names in appropriate locations.

(5) Sequence of Operation: Provide a graphic screen displaying the written out full sequence of operation for each piece of HVAC equipment. Provide a link to the sequence of operation displays on their respective equipment graphics.

b. Graphic Title: Provide a prominent, descriptive title on each graphic page.

c. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.

d. Graphic Linking: Provide forward and backward linking between floor plans, sub-plans, and equipment.

e. Graphic Editing: Provide installed software to create, modify, and delete the DDC graphics. Include the ability to store graphic symbols in a symbol directory and import these symbols into the graphics.

f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on the graphics.

2.1.4 Notebook Computer

Provide a notebook computer, complete with the project's installed DDC software, applications database, and graphics to fully troubleshoot and program the project's devices. Notebook computers for web-based systems do not require this installed software if they have the ability to connect locally in real time, view all graphics, and fully troubleshoot, modify, and program all project devices. Provide the notebook computer with ballistic nylon carrying case with shoulder strap with all necessary cables and interface hardware needed for setup and communication with the controllers and control system components.

At a minimum the notebook computer shall include: a Microsoft XP Professional operating system, processor with capability and speed required by application software, 40 giga-byte hard drive, 512 mega-byte RAM, 2 USB 2.0 ports, 10/100 network interface card,ARCnet card, MS/TP card, internal V.92 modem, 15-inch display, keyboard, 3-hour battery with charger, 52X internal CD-RW drive with CD creator software, and Microsoft Office bundled software. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide the manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner.

2.1.5 BACnet Protocol Analyzer

Provide a BACnet protocol analyzer and required cables and fittings for connection to the BACnet network. The analyzer shall include the following minimum capabilities:

a. Capture and store to a file data traffic on all network levels.

b. Measure bandwidth usage.

c. Filtering options with ability to ignore select traffic.

2.2 SENSORS AND INPUT HARDWARE

Coordinate sensor types with the BAS Owner to keep them consistent with existing installations.

2.2.1 Field-Installed Temperature Sensors

Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.

2.2.1.1 Thermistors

Precision thermistors may be used in applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution error shall be kept to 0.1 degrees F. Total error for a thermistor circuit shall not exceed 0.5 degrees F.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F.

2.2.1.3 Temperature Sensor Details

a. Room Type: Provide the sensing element components within a decorative protective cover suitable for surrounding decor. Provide room temperature sensors, setpoint adjustment lever, digital temperature display. Provide a communication port or 802.11x wireless support for a portable operator interface like a notebook computer or PDA.

b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.

c. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 feet.

d. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.

e. Outside Air Type: Provide the sensing element on the building's north

side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.

2.2.2 Transmitters

Provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

2.2.2.1 Relative Humidity Transmitters

Provide transmitters with an accuracy equal to plus or minus 5 percent from 0 to 90 percent scale, and less than one percent drift per year. Sensing elements shall be the polymer type.

2.2.2.2 Pressure Transmitters

Provide transmitters integral with the pressure transducer.

2.2.3 Current Transducers

Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.

2.2.4 Air Quality Sensors

Provide power supply for each sensor.

2.2.4.1 CO2 Sensors

Provide photo-acoustic type CO2 sensors with integral transducers and linear output. The devices shall read CO2 concentrations between 0 and 2000 ppm with full scale accuracy of at least plus or minus 100 ppm.

2.2.4.2 Air Quality Sensors

Provide full spectrum air quality sensors using a hot wire element based on the Taguchi principle. The sensor shall monitor a wide range of gaseous volatile organic components common in indoor air contaminants like paint fumes, solvents, cigarette smoke, and vehicle exhaust. The sensor shall automatically compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC, and have a service rating of 32 to 140 degrees F and 5 to 95 percent relative humidity.

2.2.5 Input Switches

2.2.5.1 Timed Local Overrides

Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to

return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24 hour continuous operation.

2.2.6 Freeze Protection Thermostats

Provide special purpose thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 40 square feet. Provide longer elements for larger coils at 1-foot of element for every 4 square feet of coil face area, or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

2.2.7 Air Flow Measurement Stations

Air flow measurement stations shall have an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be the RTD or thermistor type, traversing the ducted air in at least two directions. The air flow pressure drop across the station shall not exceed 0.08 inch water gage at a velocity of 2,000 fpm. The station shall be suitable for air flows up to 5,000 fpm, and a temperature range of 40 to 120 degrees F. The station's measurement accuracy over the range of 125 to 2,500 fpm shall be plus or minus 3 percent of the measured velocity. Station transmitters shall provide a linear, temperature-compensated 4 to 20 mA or 0 to 10 VDC output. The output shall be capable of being accurately converted to a corresponding air flow rate in cubic feet per minute. Transmitters shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the measurement.

2.2.8 Energy Metering

2.3 OUTPUT HARDWARE

2.3.1 Control Dampers

Provide factory manufactured galvanized 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 galvanized steel channels with mitered and welded corners. Damper axles shall be 0.5 inches minimum diameter plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings.

Dampers shall be rated for not less than 2000 fpm air velocity. The pressure drop through each damper when full-open shall not exceed 0.04 inches water gage at 1000 fpm face velocity. Damper assemblies in ductwork subject to above 3-inch water gauge static air pressure shall be constructed to meet SMACNA Seal Class "A" construction requirements.

Provide the damper operating linkages outside of the air stream, including crank arms, connecting rods, and other hardware that transmits motion from

the damper actuators to the dampers, shall be adjustable. Additionally, operating linkages shall be designed and constructed to have a 2 to 1 safety factor when loaded with the maximum required damper operating force. Linkages shall be brass, bronze, galvanized steel, or stainless steel.

Provide access doors or panels in hard ceilings and walls for access to all concealed damper operators and damper locking setscrews.

For field-installed control dampers, a single damper section shall have blades no longer than 48 inches and no higher than 72 inches. The maximum damper blade width shall be 12 inches. Larger sized dampers shall be built using a combination of sections.

Frames shall be at least 2 inches wide. Flat blades shall have edges folded for rigidity. Blades shall be provided with compressible gasket seals along the full length of the blades to prevent air leakage when closed.

The damper frames shall be provided with jamb seals to minimize air leakage. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F.

The leakage rate of each damper when full-closed shall be no more than 4 cfm per sq. foot of damper face area at 1.0 inches water gage static pressure.

2.3.2 Control Valves

2.3.2.1 Valve Assembly

Valve bodies shall be designed for 125 psig minimum working pressure or 150 percent of the operating pressure, whichever is greater. Valve stems shall be Type 316 stainless steel. Valve leakage ratings shall be 0.01 percent of rated Cv value. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall meet the requirements of ASME B16.5. Cast iron valve components shall meet the requirements of ASTM A 126 Class B or C.

2.3.2.2 Butterfly Valves

Butterfly valves shall be the threaded lug type suitable for dead-end service and for modulation to the fully-closed position, with stainless steel shafts supported by bearings, non-corrosive discs geometrically interlocked with or bolted to the shaft (no pins), and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a means of manual operation independent of the actuator.

2.3.2.3 Two-Way Valves

Two-way modulating valves shall have an equal percentage characteristic.

2.3.2.4 Three-Way Valves

Three-way valves shall have an equal percentage characteristic.

2.3.2.5 Valves for Chilled Water, Condenser Water, and Glycol Fluid Service

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3

inches shall have flanged connections.

b. Internal valve trim shall be brass or bronze, except that valve stems shall be stainless steel.

c. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

d. Valves 4 inches and larger shall be butterfly valves, unless indicated otherwise.

2.3.2.6 Valves for Hot Water Service

Valves for hot water service below 250 Degrees F:

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.

b. Internal trim (including seats, seat rings, modulation plugs, valve stems, and springs) of valves controlling water above 210 degrees F shall be Type 316 stainless steel.

c. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Valve stems shall be Type 316 stainless steel.

d. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

e. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

f. Valves 4 inches and larger shall be butterfly valves, unless indicated otherwise.

2.3.3 Actuators

Provide direct-drive electric actuators for all control applications, except where indicated otherwise.

2.3.3.1 Electric Actuators

Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators shall function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds. Provide two-position actuators of single direction, spring return, or reversing type. Provide modulating actuators capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Thermal

type actuators may only be used on terminal fan coil units, terminal VAV units, convectors, and unit heaters. Spring return actuators shall be provided on all control dampers and all control valves except terminal fan coil units, terminal VAV units, convectors, and unit heaters; unless indicated otherwise. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.

2.3.4 Output Signal Conversion

2.3.5 Output Switches

2.3.5.1 Control Relays

Field installed and DDC panel relays shall be double pole, double throw, UL listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

2.4.1 Surge and Transient Protection

2.4.1.1 Controller Input/Output Protection

Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.4.2 Wiring

Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all normally visible or otherwise exposed wiring in conduit. Where conduit is required, control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits over 100 volts in conduit, metallic tubing, covered metal raceways, or armored cable. Use plenum-rated cable for circuits under 100 volts in enclosed spaces. Examples of these spaces include HVAC plenums, within walls, above suspended ceilings, in attics, and within ductwork.

2.4.2.1 Power Wiring

The following requirements are for field-installed wiring:

a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.4.2.2 Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service.

Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

2.5 FIRE PROTECTION DEVICES

2.5.1 Duct Smoke Detectors

Provide duct smoke detectors in HVAC ducts in accordance with NFPA 72 and NFPA 90A, except as indicated otherwise. Provide UL listed or FM approved detectors, designed specifically for duct installation.

2.6 INDICATORS

2.6.1 Thermometers

Provide bi-metal type thermometers at locations shown. Thermometers shall have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy shall be plus or minus 2 percent of the scale range.

2.6.2 Pressure Gauges for Piping Systems

Provide pipe-mounted pressure gauges at the locations shown. Gauges shall conform to ASME B40.100 and have a 4-inch diameter dial and shutoff cock. Provide gauges in steam piping with a pressure snubber pigtail fitting. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy shall be plus or minus 2 percent of the scale range.

PART 3 EXECUTION

3.1 INSTALLATION

Perform the installation under the supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 BACnet Naming and Addressing

Coordinate with the BAS Owner and provide unique naming and addressing for BACnet networks and devices.

a. MAC Address

Every BACnet device shall have an assigned and documented MAC Address unique to its network. For Ethernet networks, document the MAC Address assigned at its creation. For ARCNET or MS/TP, assign from 00 to 64.

b. Network Numbering

Assign unique numbers to each new network installed on the BACnet internetwork. Provide ability for changing the network number; either by device switches, network computer, or field operator interface. The BACnet internetwork (all possible connected networks) can contain up to 65,534 possible unique networks.

c. Device Object Identifier Property Number

Assign unique Device "Object_Identifier" property numbers or device instances for each device on the BACnet internetwork. Provide for future modification of the device instance number; either by device switches, network computer, or field interface. BACnet allows up to 4,194,302 possible unique devices per internetwork.

d. Device Object Name Property Text

The Device Object Name property field shall support 32 minimum printable characters. Assign unique Device "Object_Name" property names with plain-English descriptive names for each device
For example, the Device Object Name that for the device controlling the chiller plant at Building 3408 would be:

Device Object_Name = CW System B3408

A Device Object Name for a VAV box controller might be:

Device Object_Name = VAV BOX25

e. Object Name Property Text (Other than Device Objects)

The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include "Zone 1 Temperature" and "Fan Start/Stop".

f. Object Identifier Property Number (Other than Device Objects)

Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor's discretion but must be approved by the Government. In this case they must be documented and unique for like object types within the device.

3.1.2 Minimum BACnet Object Requirements

a. Use of Standard BACnet Objects

For the following points and parameters, use standard BACnet objects, where all relevant object properties can be read using BACnet's Read Property Service, and all relevant object properties can be modified using BACnet's Write Property Service:
All device physical inputs and outputs, all set points, all PID tuning parameters, all calculated pressures, flow rates, and consumption values, all alarms, all trends, all schedules, and all equipment and lighting circuit operating status.

b. BACnet Object Description Property

The Object Description property shall support 32 minimum printable characters. For each object, complete the description property field using a brief, narrative, plain English description specific to the object and project application. For example: "HW Pump 1 Proof." Document compliance, length restrictions, and whether the description is writeable in the device PICS.

c. Analog Input, Output, and Value Objects

Support and provide Description and/or Device_Type text strings matching signal type and engineering units shown on the points list.

d. Binary Input, Output, and Value Objects

Support and provide Inactive_Text and Active_Text property descriptions matching conditions shown on the points list.

e. Calendar Object

For devices with scheduling capability, provide at least one Calendar Object with ten-entry capacity. All operators may view Calendar Objects; authorized operators may make modifications from a workstation. Enable the writeable Date List property and support all calendar entry data types.

f. Schedule Object

Use Schedule Objects for all building system scheduling. All operators may view schedule entries; authorized operators may modify schedules from a workstation.

g. Loop Object or Equal

Use Loop Objects or equivalent BACnet objects in each applicable field device for PID control. Regardless of program method or object used, allow authorized operators to adjust the Update Interval, Setpoint, Proportional Constant, Integral Constant, and Derivative Constant using BACnet read/write services.

3.1.3 Minimum BACnet Service Requirements

a. Command Priorities

Use commandable BACnet objects to control machinery and systems, providing the priority levels listed below. If the sequence of operation requires a different priority, obtain approval from the Contracting Officer.

Priority Level	Application
1	Manual-Life Safety
2	Automatic-Life Safety
3	(User Defined)
4	(User Defined)
5	Critical Equipment Control
6	Minimum On/Off
7	(User Defined)
8	Manual Operator
9	(User Defined)
10	(User Defined)
11	Load Shedding
12	(User Defined)
13	(User Defined)
14	(User Defined)
15	(User Defined)
16	(User Defined)

b. Alarming

(1) Alarm Priorities - Coordinate alarm and event notification with the BAS Owner.

(2) Notification Class - Enable writeable Priority, Ack Required, and Recipient List properties of Notification Class objects.

(3) Event Notification Message Texts - Use condition specific narrative text and numerical references for alarm and event notification.

c. Updating Displayed Property Values

Allow workstations to display property values at discrete polled intervals, or based on receipt of confirmed and unconfirmed Change of Value notifications. The COV increment shall be adjustable by an operator using BACnet services, and polled intervals shall be adjustable at the operator workstation.

3.1.4 Local Area Networks

Obtain Government approval before connecting new networks with existing networks. Network numbers and device instance numbers shall remain unique when joining networks. Do not change existing network addressing without Government approval. See also "BACnet Naming and Addressing".

3.1.5 BACnet Routers, Bridges, and Switches

Provide the quantity of BACnet routers, bridges, and switches necessary for communications shown on the BACnet Communication Architecture schematic. Provide BACnet routers with BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network. Configure each BACnet device and bridge, router, or switch to communicate on its network segment.

3.1.6 Wiring Criteria

a. Run circuits operating at more than 100 volts in rigid or flexible conduit, metallic tubing, covered metal raceways, or armored cable.

b. Do not run binary control circuit wiring in the same conduit as power wiring over 100 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 100 volts.

c. Provide circuit and wiring protection required by NFPA 70.

d. Run all wiring located inside mechanical rooms in conduit.

e. Do not bury aluminum-sheathed cable or aluminum conduit in concrete.

f. Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Number each pneumatic tube every six feet. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring

methods shall be in accordance with UL 508A.

g. For controller power, provide new 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable.

h. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.

i. Grounding: Ground controllers and cabinets to a good earth ground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit grounding is not acceptable; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at the controller end.

j. The Contractor shall be responsible for correcting all associated ground loop problems.

k. Run wiring in panel enclosures in covered wire track.

3.1.7 Accessibility

Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install digital controllers, data ports, and concealed actuators, valves, dampers, and like equipment in locations freely accessible through access doors.

3.1.8 Digital Controllers

a. Install as stand alone control devices (see definitions).

b. Locate control cabinets at the locations shown on the drawings. If not shown on the drawings, install in the most accessible space, close to the controlled equipment.

3.1.9 Hand-Off-Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.10 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.10.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of the sensor at the heights indicated.

3.1.10.2 Duct Temperature Sensors

a. Probe Type: Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. Seal the duct insulation penetration vapor tight.

b. Averaging Type (and coil freeze protection thermostats): Weave the capillary tube sensing element in a serpentine fashion perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports. Prevent contact between the capillary and the duct or air handler internals. Provide a duct access door at the sensor location. The access door shall be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors shall be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.10.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.

3.1.10.4 Outside Air Temperature Sensors

Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.11 Damper Actuators

Where possible, mount actuators outside the air stream in accessible areas.

3.1.12 Thermometers and Gages

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.13 Pressure Sensors

Locate pressure sensors as indicated.

3.1.14 Component Identification Labeling

Using an electronic hand-held label maker with white tape and bold black block lettering, provide an identification label on the exterior of each new control panel, control device, actuator, and sensor. Also provide labels on the exterior of each new control actuator indicating the (full) open and (full) closed positions. For labels located outdoors, use exterior grade label tape, and provide labels on both the inside and outside of the panel door or device cover. Acceptable alternatives are white plastic labels with engraved bold black block lettering permanently attached to the control panel, control device, actuator, and sensor. Have the labels and

wording approved by the BAS Owner prior to installation.

3.1.15 Network and Telephone Communication Lines

When telephone lines or network connections by the Government are required, provide the Contracting Officer at least 60 days advance notice of need.

3.2 TEST AND BALANCE SUPPORT

The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel specified under Section 23 05 93 TESTING, ADJUSTING AND BALANCING. This support shall include:

a. On-site operation and manipulation of control systems during the testing and balancing.

b. Control setpoint adjustments for balancing all relevant mechanical systems, including VAV boxes.

c. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.3 CONTROLS SYSTEM OPERATORS MANUALS

Provide two four electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Government, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:

a. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph "Submittals." Indicate all field changes and modifications.

b. A copy of the project's mechanical design drawings, including any official modifications and revisions.

c. A copy of the project's approved Product Data submittals provided under the paragraph "Submittals."

d. A copy of the project's approved Performance Verification Testing Plan and Report.

e. A copy of the project's approved final TAB Report.

f. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.

g. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.

h. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.

i. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.

j. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.

k. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support at no additional cost to the Government for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.

l. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Government for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

3.4 PERFORMANCE VERIFICATION TESTING (PVT)

3.4.1 General

The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Government. If the project is phased, provide separate testing for each phase. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator, the Contracting Officer's representative,.

3.4.2 Performance Verification Testing Plan

Submit a detailed PVT Plan of the proposed testing for Government approval. Develop the PVT Plan specifically for the control system in this contract. The PVT Plan shall be an clear list of test items arranged in a logical sequence. Include the intended test procedure, the expected response, and the pass/fail criteria for every component tested.

The plan shall clearly describe how each item is tested, indicate where

assisting personnel are required (like the mechanical contractor), and include what procedures are used to simulate conditions. Include a separate column for each checked item and extra space for comments. Where sequences of operations are checked, insert each corresponding routine from the project’s sequence of operation. For each test area, include signature and date lines for the Contractor's PVT administrator, the Contractor's QA representative, the Contracting Officer's representative, and the BAS Owner to acknowledge successful completion.

3.4.3 PVT Sample Size

Test all central plant equipment and primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control like VAV boxes and fan coil units. The Government may require testing of like controllers beyond a statistical sample if sample controllers require retesting or do not have consistent results.

The Government may witness all testing, or random samples of PVT items. When only random samples are witnessed, the Government may choose which ones.

3.4.4 Pre-Performance Verification Testing Checklist

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.

a. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).

b. Verify HVAC motors operate below full-load amperage ratings.

c. Verify all required control system components, wiring, and accessories are installed.

d. Verify the installed control system architecture matches approved drawings.

e. Verify all control circuits operate at the proper voltage and are free from grounds or faults.

f. Verify all required surge protection is installed.

g. Verify the A/C Power Table specified in "CONTROLS SYSTEM OPERATORS MANUALS" is accurate.

h. Verify all DDC network communications function properly, including uploading and downloading programming changes.

i. Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.

j. Verify each digital controller’s programming is backed up.

k. Verify all wiring, components, and panels are properly labeled.

l. Verify all required points are programmed into devices.

m. Verify all TAB work affecting controls is complete.

n. Verify all valve and actuator zero and span adjustments are set properly.

o. Verify all sensor readings are accurate and calibrated.

p. Verify each control valve and actuator goes to normal position upon loss of power.

q. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.

r. Verify each controller works properly in stand-alone mode.

s. Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.

t. Verify all electrical interlocks work properly.

u. Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook.

v. Verify the as-built (shop) control drawings are completed.

3.4.5 Conducting Performance Verification Testing

a. Conduct Government-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the Contracting Officer of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT. Ensure that testing personnel are regularly employed in the testing and calibration of DDC systems. Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

b. During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.

c. If re-testing is required, follow the procedures for the initial PVT. The Government may require re-testing of any control system components affected by the original failed test.

3.4.6 Controller Capability and Labeling

Test the following for each controller:

a. Memory: Demonstrate that programmed data, parameters, and trend/ alarm history collected during normal operation is not lost during power failure.

b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a portable electronic device

like a notebook computer or PDA. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.

c. Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.

d. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control drawings. Demonstrate the ability to locate a controller's location using the BACnet Communication Architecture Schematic and floor plans.

e. Nameplates and Tags: Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

3.4.7 Workstation and Software Operation

For every user workstation or notebook provided:

a. Show points lists agree with naming conventions.

b. Show that graphics are complete.

c. Show the UPS operates as specified.

3.4.8 BACnet Communications and Interoperability Areas

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a BACnet protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

a. Data Presentation: On each BACnet Operator Workstation, demonstrate graphic display capabilities.

b. Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.

c. Setpoint and Parameter Modifications: Show the ability to modify all setpoints and tuning parameters in the sequence of control or listed on project schedules. Modifications are made with BACnet messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.

d. Peer-to-Peer Data Exchange: Show all BACnet devices are installed and configured to perform BACnet read/write services directly (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.

e. Alarm and Event Management: Show that alarms/events are installed and prioritized according to the BAS Owner. Demonstrate time delays and other logic is set up to avoid nuisance tripping, e.g., no status alarms during unoccupied times or high supply air during cold morning start-up. Show that operators with sufficient privilege can read and

write alarm/event parameters for all standard BACnet event types. Show that operators with sufficient privilege can change routing (BACnet notification classes) for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved (TO-OFF NORMAL, TO-NORMAL, etc.).

f. Schedule Lists: Show that schedules are configured for start/stop, mode change, occupant overrides, and night setback as defined in the sequence of operations.

g. Schedule Display and Modification: Show the ability to display any schedule with start and stop times for the calendar year. Show that all calendar entries and schedules are modifiable from any connected workstation by an operator with sufficient privilege.

h. Archival Storage of Data: Show that data archiving is handled by the operator workstation/server, and local trend archiving and display is accomplished with BACnet Trend Log objects.

i. Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.

j. Device and Network Management: Show the following capabilities:

(1) Display of Device Status Information

(2) Display of BACnet Object Information

(3) Silencing Devices that are Transmitting Erroneous Data

(4) Time Synchronization

(5) Remote Device Reinitialization

(6) Backup and Restore Device Programming and Master Database(s)

(7) Configuration Management of Half-Routers, Routers and BBMDs

3.4.9 Execution of Sequence of Operation

Demonstrate that the HVAC system operates properly through the complete sequence of operation. Use read/write property services to globally read and modify parameters over the internetwork.

3.4.10 Control Loop Stability and Accuracy

For all control loops tested, give the Government trend graphs of the control variable over time, demonstrating that the control loop responds to a 20 percent sudden change of the control variable set point without excessive overshoot and undershoot. If the process does not allow a 20 percent set point change, use the largest change possible. Show that once the new set point is reached, it is stable and maintained. Control loop trend data shall be in real-time with the time between data points 30 seconds or less.

3.4.11 Performance Verification Testing Report

Upon successful completion of the PVT, submit a PVT Report to the

Government and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.

3.5 TRAINING REQUIREMENTS

Provide a qualified instructor (or instructors) with two years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times with the Contracting Officer and BAS Owner after receiving approval of the training course documentation. Training shall take place at the job site and/or a nearby Government-furnished location. A training day shall occur during normal working hours, last no longer than 8 hours and include a one-hour break for lunch and two additional 15-minute breaks. The project's approved Controls System Operators Manual shall be used as the training text. The Contractor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of training.

3.5.1 Training Documentation

Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopses of each lesson, and the instructor's background and qualifications. The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

3.5.2 Phase I Training - Fundamentals

The Phase I training session shall last one day and be conducted in a classroom environment with complete audio-visual aids provided by the contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all visual aids used. Upon completion of the Phase I Training, each trainee should fully understand the project's DDC system fundamentals. The training session shall include the following:

a. BACnet fundamentals (objects, services, addressing) and how/where they are used on this project

b. This project's list of control system components

c. This project's list of points and objects

d. This project's device and network communication architecture

e. This project's sequences of control, and:

f. Alarm capabilities

g. Trending capabilities

h. Troubleshooting communication errors

i. Troubleshooting hardware errors

3.5.3 Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The Phase II training session shall last one day and be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Phase II Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:

a. A walk-through tour of the mechanical system and the installed DDC components (controllers, valves, dampers, surge protection, switches, thermostats, sensors, etc.)

b. A discussion of the components and functions at each DDC panel

c. Logging-in and navigating at each operator interface type

d. Using each operator interface to find, read, and write to specific controllers and objects

e. Modifying and downloading control program changes

f. Modifying setpoints

g. Creating, editing, and viewing trends

h. Creating, editing, and viewing alarms

i. Creating, editing, and viewing operating schedules and schedule objects

j. Backing-up and restoring programming and data bases

k. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics

l. Creating new graphics and adding new dynamic data displays and links

m. Alarm and Event management

n. Adding and removing network devices

-- End of Section --

SECTION 44 40 10

WATER REUSE 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.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(2008; Errata 2008; Errata 2008; Errata 2009; Addendum 2009; Errata 2010) Specification for Pipeline Valves

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution

AMERICAN WELDING SOCIETY (AWS)

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

ASME INTERNATIONAL (ASME)

ASME B31.1	(2007; Addenda a 2008; Addenda b 2009) Power Piping
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2564	(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure

	Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(2006) PTFE Resin Skived Tape
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

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

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	(2006) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-78	(2005a) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2009) Motors and Generators

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

1.2 SYSTEM DESCRIPTION

1.2.1 SUMMARY

This Section includes water reuse systems for:

a. rain water
b. gray water

1.2.1.1 DEFINITIONS

a. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified herein.

b. Definitions pertaining to water reuse: As defined in ASTM E2635 and as specified herein.

c. Black water: untreated wastewater from urinals and water closets.

d. Gray water: untreated wastewater from bathtubs, showers, bathroom wash basins, clothes washing machines, and luandry tubs. It may also include condensation pan water from refrigeration equipment and air-conditioners, hot tub drain water, pond and fountain drain water, and cistern drain water.

e. Reclaimed water: Water that is used more than one time before it passes back into the natural water cycle. Reclaimed water is considered nonpotable but may be highly treated and used for approved purposes other than drinking water.

f. Recycled water: See reclaimed water.

g. Water reuse: cycling water one or more times for beneficial use as reclaimed water.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Equipment Installation; G

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

SD-03 Product Data

Water Effeciency

Indicate water reuse rates in gallons per day (gpd) per unit for the following:

1. In situ water reclamation

Water Budget

Submit water budget statement; include calculations used in development of water budget. Indicate how approved water budget increases water effeciency over baseline; and, indicate how water reuse system(s) complies with approved water budget.

1. Baseline: Calculate baseline water budget using occupancy rate and EPAct 1992 standards for water fixtures.

SD-06 Test Reports

Testing

Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed

to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Treatment Plant Installation; G

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Manuals shall be approved prior to the field training course.

1.4 QUALIFICATIONS

Procedures and welders shall be qualified in accordance with the code under which the welding is specified to be accomplished.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity, excessive temperature variation, and dirt, dust, or other contaminants.

1.6 QUALITY ASSURANCE

a. Regulatory Requirements: Conform to the International Plumbing Code and applicable codes, rules, and regulations.

b. Designer/Installer Qualifications: For work of this Section, engage an experienced licensed plumbing contractor who has specialized in systems similar to those required for this Project and with a record of successful in-service performance. Contractor shall:

1. Have a minimum 3 years experience designing, constructing, and installing water reuse system similar to requirements for this Project.

c. Pre-Installation Meetings:

1. Convene a pre-installation meeting minimum one week prior to commencing work of this Section.

2. Require attendance of parties directly affecting Work of this Section.

a. Coordinate with installtion of plumbing fixtures, equipment, and piping.
b. Coordinate with rainwater harvesting system.
c. Coordinate with municipal supplier.

3. Review conditions of operations, procedures and coordination with related Work.

4. Agenda

a. Tour, inspect, and discuss conditions of work.
b. Review installation schedule
c. Review required permits and inspections.
d. Review monitoring and maintenance.
e. Review environmental procedures.

d. Operation and Maintenance Manuals Submittals:

1. Instruction indicating procedures for routine operation and maintenance of water reuse system(s) as appropriate to:

a. municipal-supplied reclaimed water
b. in situ water reclamation utilizing:

1. rain water
2. gray water
3. black water

2. Instructions indicating procedures for normal and peak loading conditions, and periods of shutdown.

a. Peak loading conditions shall include peak hydraulic loading and pollutant loading conditions.
b. Period of shutdown shall include power failures, equipment failure, and normal maintenance shutdowns.

3. Instructions indicating procedures for emergency response in the event of a failure of the system.

1.7 Monitoring and Maintenance

Provide regular maintenance for minimum one year from date of substatial completion.

1. Monitor system daily to asses performance.

a. Verify components are adjusted and functioning properly.
b. Verify water quality is satisfactory for intended use. If in situ water reuse systems are used, monitor and test water quality in accordance with ASTM E2635.
c. Verify water reuse rate is consistent with water budget.

2. Make minor adjustments, if any, as necessary.

3. Document system performance including:

a. Rate and amount of water reuse.
b. Quality of reclaimed water. If in situ water reuse systems are used, document quality of reclaim water before and after treatment.
c. Adjustments, if any, to system.

4. Provide recommendations for improvement to the system.

PART 2 PRODUCTS

2.1 WATER REUSE SYSTEM

2.1.1 General

Provide system designed with easy access for effective monitoring program and for effective maintenance and process control program.

Provide dual distribution systems to prevent cross-connections of reclaimed water and potable water lines and the misuse of reclaimed water.

a. Marking: Clearly mark distribution piping and use lavander (light purple) pipes to distinguish it from potable water. Provide piping certified and labeled "NSF-rw" in accordance with NSF Pipe Certification for Reclaimed Water End Use protocols.

Provide backflow prevention devices on reclaimed water lines to preclude the likelihood of incidental human misuse.

2.1.2 In situ Water Reclamation

Comply with requirements os ASTM E2635 and as follows:

1. Water reclamation system shall be designed and implemented to provide for reliability and redundancy. System design shall take into account operations and treatment during normal and peak loading conditions, and periods of shutdown.

2. Source water: Water captured from one or more of the following:

a. rain water
b. gray water

2.2 MATERIALS

Materials shall conform to the following requirements:

2.2.1 Polyvinyl Chloride (PVC) Pipe and Fittings

PVC pipe and fittings less than 4-inch diameter shall be in accordance with ASTM D 1785 or ASTM D 2241. PVC pipe and fittings 4 inch in diameter and larger shall be in accordance with ASTM D 2241 or AWWA C900 and shall have push-on joints.

2.2.1.1 Push-On Joints

Push-on joints shall conform to ASTM D 3139 or ASTM F 477.

2.2.1.2 Solvent Cement

Solvent cement shall conform to ASTM D 2564.

2.2.2 Pipe Hangers and Supports

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.2.3 Valves

2.2.3.1 Angle, Check, and Globe Valves

Angle, check and globe valves shall conform to MSS SP-80, Type 3 Globe and Angle, Types 3 and 4 Check.

2.2.3.2 Gate Valves

Gate valves shall conform to MSS SP-80, Type 1, Class 150 or MSS SP-70, Type I, Class 125 Bronze Trim.

2.2.3.3 Plug Valves

Bronze plug valves shall conform to MSS SP-78. Iron plug valves shall conform to API Spec 6D.

2.2.4 Joint Compound

Joint compound for screwed joints shall be a stiff mixture of graphite and oil, inert filler and oil, or a graphite compound.

2.2.5 Joint Tape

Joint tape for screw joints shall conform to ASTM D 3308.

2.2.6 Bolts and Nuts

Bolts and nuts shall conform to ASTM A 307, Grade B.

2.3 EQUIPMENT

Equipment shall conform to the following requirements:

2.3.1 Electric Motors

Electric motors shall conform to NEMA MG 1.

2.3.2 Motor Controls

Motor Controls shall conform to NEMA ICS 1.

2.3.3 Protection from Moving Parts

All belts, chains, couplings, and other moving parts shall be completely enclosed by guards to prevent accidental personal injury. Guards shall be removable or so arranged as to allow access to the equipment for maintenance. If equipment is housed in a lockable enclosure, this shall be sufficient protection and no additional guards are necessary.

2.4 AIR-DIFFUSION EQUIPMENT

2.4.1 Piping and Valves

Piping shall be Schedule 80 PVC. Isolation-control valves shall be gate valves. A minimum of three separate air-diffusion headers per tank shall be provided. Headers shall be independently valved and supported and shall be capable of being independently removed from service without the use of a

crane or hoist and without dewatering of the tank.

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 FIELD QUALITY CONTROL

Water: Coordinate with work specified in Environmental Management to provide water monitoring for surface and groundwater.

Field Inspection: Verify installation conforms with approved system design and applicable codes, rules, and regulations.

1. Confirm the reclaim water is disinfected by an approved method that employs one or more disinfectants such as chlorine, iodine, or ozone.
2. Confirm the distribution piping and reservoirs are identified as containing nonpotable water.

3.3 WATER REUSE CONSTRUCTION

All work not absolutely required to be performed in the field shall be performed in a factory under controlled conditions. The treatment plant shall be fabricated from not less than 1/4-inch steel plate with welded joints and shall be reinforced as necessary with steel angles, tees, or other structural members. The units shall be designed and constructed for transportation, installation, and operation without detrimental buckling, distortion, or other defects. Tanks shall not leak when filled with water or sewage.

3.3.1 Pipe and Valve Installation

Piping shall be installed in a neat manner with all joints tight and with no undue marring of finishes. Installed piping, valves, and fittings shall be free from strain and excessive stresses caused by weight or misalignment.

3.3.1.1 Flanged Joints

Bolts shall be tightened uniformly to prevent overstressing flanges and misalignment.

3.3.1.2 Screw Joints

Screw joints shall be made tight with joint compound, applied to the male threads only, or joint tape.

3.3.1.3 Push-On Joints for PVC Pipe

Pipe ends shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. Lubricate gasket to prevent displacement. Exercise care to ensure that the gasket remains in proper position in the bell or coupling while making joint.

3.3.1.4 Solvent-Weld Joints for PVC Pipe

Joints shall be made in accordance with the manufacturer's written instructions.

3.3.1.5 Valves

Valves shall be installed with the stem vertical and located for easy access for operation.

3.3.2 Equipment Installation

Equipment shall be installed in compliance with the manufacturer's written instructions.

3.3.3 Electrical Work

Electrical work shall be in accordance with the applicable requirements of Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.4 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. The framed instructions shall be posted before acceptance testing of the system.

3.5 TREATMENT PLANT INSTALLATION

The plant shall be installed such that proper wastewater flow through the plant will be achieved.

3.5.1 Preparation

Excavation, filling, and backfilling shall be in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. A reinforced concrete foundation pad, of the size and design recommended by the treatment plant manufacturer, shall be installed in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.2 Installation

The water reuse plant and equipment shall be installed in accordance with the manufacturer's written instructions.

3.5.3 Testing and Adjusting

Prior to backfilling, all tanks, wet-wells, piping, valves, and appurtenances shall be filled and inspected for leaks in accordance with manufacturer's specifications. All leaks shall be repaired by removal of defective materials or rewelding. Use of caulking compounds is not permitted. Testing and repairs shall be repeated until tanks, wetwells, piping, valves, and appurtenances are free from leaks. As soon as practicable after completion, an operating test of the treatment plant and all equipment shall be performed to demonstrate that the plant functions

properly. After completion of all tests, the plant shall be adjusted for proper operation while on-line with the wastewater source in accordance with the manufacturer's written instructions. For final acceptance plant must perform as specified.

3.6 WELDING

3.6.1 Procedures

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with AWS D1.1/D1.1M.

3.6.2 Testing

3.6.2.1 Correction of Defective Welds

Repair weld areas containing defects; additional tests of repaired areas shall be made at Contractor's expense. If 20 percent or more of welds made by a given welder contain defects requiring repair, 100 percent nondestructive inspection of that welder's work will be required at Contractor's expense.

3.7 PAINTING

All metal surfaces, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Unless otherwise specified, surface preparation and painting may be performed in the shop or in the field. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.7.1 Preparation and Application

Ferrous metal surfaces shall be prepared in accordance with SSPC SP 10/NACE No. 2. Nonsubmersed surfaces shall receive 4 to 5 mils dry film thickness (dft) of epoxy metal primer, finished with coat of epoxy enamel (4.0 to 6.0 mils dft) plus coat of polyurethane enamel (1.0 to 2.0 mils dft). Submerged surfaces shall use 2 coats of coal tar bitumastic of 8 mils to 10 mils dft each or 2 coats of amine-cured coal tar epoxy to 14.0 to 20.0 mils total dft.

3.7.2 Coating Testing

Coatings shall be examined for flaws and tested for thickness and holidays. Thickness of coatings shall be measured by a commercial film thickness gauge. Coatings shall be tested for pinholes, holidays, and other defects with an electric flaw detector equipped with an audible signal that operates when a pinhole is detected. The detector shall be a 90-volt wet sponge pinhole detector.

3.7.3 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 10/NACE No. 2 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.8 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment in accordance with the manufacturer's written instructions.

3.9 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 8 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
Facilities Support Center Amendment #4

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 14 00	SD-01 Preconstruction Submittals															
			List of Contact Personnel		G													
		01 20 00.00 20	SD-01 Preconstruction Submittals															
			Schedule of prices	1.2	G													
			SD-11 Closeout Submittals															
			As-Built Drawings															
			Contractor's Invoice															
		01 30 00	SD-01 Preconstruction Submittals															
			List of contact personnel		G													
			View location map	1.3	G													
			Progress and completion pictures	1.4	G													
			Personnel list	1.5.2	G													
			Vehicle list		G													
			SD-04 Samples															
			Color boards	1.2	G													
		01 32 01.00 10	SD-01 Preconstruction Submittals															
			Project Schedule	3.1.1	G													
			Progress Schedule	3.2.1.1	G													
		01 33 00	SD-01 Preconstruction Submittals															
			Updated Submittal Register	1.7	G													
		01 33 29	SD-01 Preconstruction Submittals															
			LEED Implementation Plan	1.4	G													
			SD-11 Closeout Submittals															
			LEED Documentation Notebook	1.5	G													
		01 35 14.11 40	SD-01 Preconstruction Submittals															

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 14.11 40	Contractor's Accident Prevention	1.8.1	G													
			Plan															
			Activity Hazard Analysis	1.9.1	G													
			Request for Excavation and	1.17.1	G													
			Digging Permit															
			Request for Confined Space	1.28	G													
			Entry Permit															
			Request for Utility Outage/Facility	1.17.3	G													
			Closure Permit															
			Request for Crane Operation	1.17.4	G													
			Permit															
			Request for Open Flame and	1.17.2	G													
			Hotwork Permit															
			SD-06 Test Reports															
			Gas Protection	1.23														
			SD-07 Certificates															
			Contractor's Accident Prevention	1.8.1														
			Plan															
			Protection Plan	1.8.2														
			License Certificates	1.20														
			Safety Meeting/Safety Inspection	1.12.2														
			sheets															
			Safety Meeting Attendance	1.12.2														
			sheets															
			SD-08 Manufacturer’s Instructions															
			Material Safety Data Sheets	1.9.2	G													

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 45 00.10 40	SD-01 Preconstruction Submittals															
			QC Plan	1.5	G													
		01 45 35	SD-07 Certificates															
			Special Inspector	1.5	G													
			Quality Assurance Plan	1.4	G													
		01 50 00	SD-01 Preconstruction Submittals															
			Construction site plan	1.4														
			Traffic control plan	3.2.1	G													
			SD-06 Test Reports															
			Backflow Preventer Tests	1.5.2														
			SD-07 Certificates															
			Backflow Tester	1.5														
			Backflow Preventers															
		01 74 19	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.5	G													
			SD-11 Closeout Submittals															
			Records	1.6														
			Salvage Material Records															
		01 78 00	SD-03 Product Data															
			As-Built Record of Equipment	1.3.2	G													
			and Materials															
			Warranty Management Plan		G													
			Warranty Tags	1.6.1														
			Final Cleaning	1.8														
			Spare Parts Data	1.4														
			SD-08 Manufacturer’s Instructions															

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 78 00	Preventative Maintenance	1.5														
			Condition Monitoring (Predictive	1.5														
			Testing)															
			Inspection	1.5														
			Instructions to be Posted															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.7														
			Manuals															
			SD-11 Closeout Submittals															
			As-Built Drawings	1.3.1	G													
			Certification of EPA Designated		G													
			Items															
			NASA Form NF1046	1.9														
		02 41 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.6.2	G													
			SD-07 Certificates															
			Demolition Plan	1.8	G													
			Notifications	1.4.1	G													
		03 30 00	SD-02 Shop Drawings															
			Reinforcing steel	1.6.2.1	G													
			Locations of the concrete slab		G													
			construction joints, expansion															
			joints and contraction joints															
			SD-03 Product Data															
			Materials for curing concrete	2.4.7														

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		03 30 00	Joint sealants	2.4.10														
			Joint filler	2.4.9														
			Plastic Forms	2.1.2														
			Carton Forms	2.1.3														
			Aggregate		G													
			Recycled Aggregate Materials	2.4.3.2	G													
			Cement	2.4.1	G													
			Portland Cement	2.4.1.3	G													
			Ready-Mix Concrete	2.3.2	G													
			Water-Vapor Barrier Subgrade	2.4.6.1														
			Cover															
			Bonding Materials	2.6														
			Floor Finish Materials	2.7														
			Concrete Curing Materials	2.3.3														
			Reinforcement	2.5	G													
			Reinforcement Materials															
			Liquid Chemical Floor Hardener	2.7.1														
			Vapor retarder															
			Vapor barrier	2.4.6														
			Epoxy bonding compound	2.4.11														
			Waterstops	2.2.1														
			Waterstops	2.4.10.3														
			Waterstops	3.14.2														
			Wood Forms	2.1.1														
			Local/Regional Materials	1.8.1	G													

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		03 30 00	Biodegradable Form Release	2.4.12														
			Agent															
			SD-04 Samples															
			Slab finish sample	1.6.5.1														
			Dumbbell Type	2.4.10.3														
			Rubber															
			Polyvinylchloride (PVC)	2.4.10.3														
			SD-05 Design Data															
			mix design	2.3.1	G													
			SD-06 Test Reports															
			Concrete mix design	1.6.4.1	G													
			Fly ash	1.6.4.2	G													
			Pozzolan	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3	G													
			slag															
			Compressive strength tests	3.12.2.3	G													
			Unit weight of structural	3.12.2.5														
			lightweight concrete															
			Slump		G													
			SD-07 Certificates															
			Curing concrete elements	1.6.3.1														
			Pumping concrete	1.6.3.2														
			Biodegradable Form Release	2.4.12														
			Agent															

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		03 30 00	VOC Content for form release	1.6.3.3														
			agents, curing compounds, and															
			concrete penetrating sealers															
			Material Safety Data Sheets	1.6.3.4														
			Forest Stewardship Council	1.8.2														
			(FSC) Certification															
			SD-08 Manufacturer's Instructions															
			Fly ash	1.6.4.2	G													
			Ground granulated blast-furnace	1.6.4.3														
			slag															
			Welding Procedures	1.10														
			Welding Procedures	1.10														
			Steel Bar	2.5.7														
			Welder Qualifications	1.10														
		04 20 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.3	G													
			SD-03 Product Data															
			Local/Regional Materials	1.2.1														
			Concrete Masonry Units (CMU)	2.2	G													
			Cement	2.5.4	G													
			Insulation	2.10														
			Flashing	2.12														
			Water-Repellant Admixture	2.6														
			Cold Weather Installation	1.6.2														
			SD-04 Samples															
			Concrete Masonry Units (CMU)	2.2	G													

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		04 20 00	Anchors, Ties, and Bar	2.8														
			Positioners															
			Expansion-Joint Materials	2.11														
			Insulation	2.10														
			SD-05 Design Data															
			Pre-mixed Mortar	2.5.5	G													
			Unit Strength Method	1.2.2.1	G													
			SD-06 Test Reports															
			Field Testing of Mortar	3.20.1	G													
			Field Testing of Grout	3.20.2	G													
			Masonry Inspector Qualifications	1.4.2	G													
			SD-07 Certificates															
			Concrete Masonry Units (CMU)	2.2														
			Anchors, Ties, and Bar	2.8														
			Positioners															
			Expansion-Joint Materials	2.11														
			Reinforcing Steel Bars and Rods	2.9														
			Mortar Coloring	2.5.2														
			Insulation	2.10														
			Insulation	2.10														
			Admixtures for Masonry Mortar	2.5.1														
			Admixtures for Grout	2.7.1														
			SD-10 Operation and Maintenance															
			Data															
			Take-Back Program	3.19.2														
			SD-11 Closeout Submittals															

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		04 20 00	Environmental Data	1.2.4	G													
		05 12 00	SD-02 Shop Drawings															
			Erection Plan	1.7.2.1	G													
			Fabrication drawings	1.7.1	G													
			SD-03 Product Data															
			Shop primer	2.4														
			Welding electrodes and rods	2.3.1														
			Load indicator washers	2.2.4														
			Non-Shrink Grout	2.3.2														
			Load indicator bolts	2.2.5														
			SD-06 Test Reports															
			Class B coating	2.4														
			Bolts, nuts, and washers	2.2														
			SD-07 Certificates															
			Steel	1.8														
			Steel	2.1														
			Bolts, nuts, and washers	2.2														
			Galvanizing	2.5														
			AISC Quality Certification	1.5														
			Welding procedures and	1.7.2.2														
			qualifications															
			SD-11 Closeout Submittals															
			Steel	1.8														
			Steel	2.1														
			Shop Primer	2.4														
		05 30 00	SD-02 Shop Drawings															

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		05 30 00	Fabrication Drawings	1.3.5	G														
			Metal Floor Deck Units	2.3	G														
			Cant Strips	2.3.3.1															
			Ridge and Valley Plates	2.3.3.2															
			Metal Closure Strips	2.3.3.3	G														
			SD-03 Product Data																
			Accessories	2.2															
			Deck Units	2.3.1	G														
			Galvanizing Repair Paint	2.1.3.1															
			Galvanizing Repair Paint	2.1.6															
			Joint Sealant Material	2.1.5															
			Mechanical Fasteners	2.2.12															
			Piston Tool Operator	1.3.2															
			Welding Equipment	1.3.3															
			Welding Rods and Accessories	1.3.3															
			SD-04 Samples																
			Metal Roof Deck Units	2.3															
			SD-05 Design Data																
			Deck Units	2.3.1	G														
			SD-07 Certificates																
			Welder Qualifications	1.3.3	G														
			Fire Safety	1.3.4.1															
			Wind Storm Resistance	1.3.4.2															
		05 40 00	SD-02 Shop Drawings																
			Framing Components	1.6.1	G														
			SD-03 Product Data																

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		05 40 00	studs,joists	2.1														
			SD-05 Design Data															
			Metal framing calculations	1.6.2	G													
			SD-07 Certificates															
			Load-bearing cold-formed metal	1.4														
			framing															
			Welds	3.1.1														
		05 50 13	SD-02 Shop Drawings															
			structural steel door frames	2.16														
			Access doors and panels	2.3														
			Cover plates and frames	2.6														
			Expansion joint covers	2.7														
			Floor gratings and roof walkways	2.9														
			Wheel guards	2.17														
			angles and plates	2.12	G													
			Roof hatch	3.11	G													
			SD-03 Product Data															
			Access doors and panels	2.3														
			Cover plates and frames	2.6														
			Control-joint covers	2.4														
			Expansion joint covers	2.7														
			Floor gratings and roof walkways	2.9														
			Structural steel door frames	2.16														
			Wheel guards	2.17														
			Roof hatch	3.11	G													
			SD-04 Samples															

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		05 50 13	Expansion joint covers	2.7														
			Control-joint covers	2.4														
		05 51 00	SD-02 Shop Drawings															
			Iron and Steel Hardware	2.1														
			Steel Shapes, Plates, Bars and	2.1														
			Strips															
			Metal Stair System	2.15														
			SD-03 Product Data															
			Structural Steel Plates, Shapes,	2.2														
			and Bars															
			Structural Steel Tubing	2.3														
			Hot-Rolled Carbon Steel Sheets	2.6														
			and Strips															
			Cold Finished Steel Bars	2.5														
			Hot-Rolled Carbon Steel Bars	2.4														
			Cold-Rolled Carbon Steel Sheets	2.7														
			Galvanized Carbon Steel Sheets	2.8														
			Cold-Drawn Steel Tubing	2.9														
			Gray Iron Castings	2.10														
			Malleable Iron Castings	2.11														
			Concrete Inserts	2.13														
			Masonry Anchorage Devices															
			Protective Coating	2.16														
			Steel Pan Stairs	2.17														
			Steel Stairs	2.17.9														
			Steel Stairs, Circular															

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		05 51 00	SD-07 Certificates															
			Welding Procedures															
			Welder Qualification	1.3														
			SD-08 Manufacturer's Instructions															
			Structural Steel Plates, Shapes,	2.2														
			and Bars															
			Structural Steel Tubing	2.3														
			Hot-Rolled Carbon Steel Sheets	2.6														
			and Strips															
			Cold Finished Steel Bars	2.5														
			Hot-Rolled Carbon Steel Bars	2.4														
			Cold-Rolled Carbon Steel Sheets	2.7														
			Galvanized Carbon Steel Sheets	2.8														
			Cold-Drawn Steel Tubing	2.9														
			Gray Iron Castings	2.10														
			Malleable Iron Castings	2.11														
			Protective Coating	2.16														
			Masonry Anchorage Devices															
		05 51 33	SD-02 Shop Drawings															
			Alternating tread stairs, platforms	2.3														
			and handrails															
			SD-03 Product Data															
			Alternating tread stairs, platforms	2.3														
			and handrails															
		05 52 00	SD-02 Shop Drawings															
			Fabrication Drawings	1.2.1	G													

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		05 52 00	Iron and Steel Hardware	2.1	G													
			Iron and Steel Hardware	3.1	G													
			Steel Shapes, Plates, Bars and	3.1														
			Strips															
			SD-03 Product Data															
			Masonry Anchorage Devices	1.2.1	G													
			Masonry Anchorage Devices	2.3	G													
			Protective Coating	1.2.1	G													
			Protective Coating	2.5	G													
			Steel and Cable Railings	2.7	G													
			SD-08 Manufacturer's Instructions															
			Installation Instructions	3.1														
			SD-11 Closeout Submittals															
			Steel and Cable Railings	2.7														
		06 41 16.00 10	SD-02 Shop Drawings															
			Shop Drawings	2.9	G													
			Installation	3.1														
			SD-03 Product Data															
			Wood Materials	2.1	G													
			Plastic Laminate		G													
			Adhesives		G													
			Cabinet Hardware	2.5	G													
			SD-04 Samples															
			Plastic Laminates	2.2	G													
			Cabinet Hardware	2.5	G													
			SD-07 Certificates															

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		06 41 16.00 10	Sustanable Design Certificate															
			Forest Stewardship Council		G													
			(FSC) Certification															
			Quality Assurance	1.4														
			Laminate Clad Casework	3.1														
			SD-11 Closeout Submittals															
			Environmental Data															
		07 12 00	SD-03 Product Data															
			Protection board	2.6														
			Prefabricated laminated asphalt	2.7														
			waterproofing															
			Membrane fabric	2.3														
			Reinforcing Fabric	3.3.2.1														
			Liquid asphalt	1.4.2														
			SD-08 Manufacturer’s Instructions															
			Application	3.3														
		07 21 16	SD-03 Product Data															
			Blanket insulation	2.1	G													
			Sill sealer insulation	2.2														
			Pressure sensitive tape	2.4														
			Adhesives		G													
			DSD-07 Certificates															
			Certification	1.4														
			SD-08 Manufacturer’s Instructions															
			Insulation	3.3.1														
			SD-11 Closeout Submittals															

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		07 21 16	Environmental Data	1.3														
		07 22 00	SD-02 Shop Drawings															
			Tapered roof insulation	2.1.4	G													
			SD-03 Product Data															
			Fasteners	2.3	G													
			Insulation	2.1	G													
			Certification	1.4.3														
			SD-06 Test Reports															
			Flame spread and smoke	1.4.1														
			developed ratings															
			SD-07 Certificates															
			qualifications	1.3														
			SD-08 Manufacturer’s Instructions															
			fasteners	2.3														
			Insulation	2.1														
		07 42 13	SD-01 Preconstruction Submittals															
			Qualification of Manufacturer	1.6.3														
			Qualification of Installer	1.6.1														
			Sample Warranty	1.6.1	G													
			SD-02 Shop Drawings															
			Installation Drawings	1.6.1.1	G													
			SD-03 Product Data															
			Wall Panels	1.6.1	G													
			Closure Materials	1.6.5														
			Pressure Sensitive Tape	2.5.4.4														
			Sealants and Caulking	2.5.4.1														

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		07 42 13	Steel Repair Paint	2.7														
			Accessories	1.6.5	G													
			SD-04 Samples															
			Wall Panels	1.6.1	G													
			Fasteners	2.4	G													
			Metal Closure Strips, 10 inches	1.6.1	G													
			long of each type															
			color charts and chips	1.6.1														
			SD-05 Design Data															
			wind load design analysis	1.6.1.2	G													
			SD-06 Test Reports															
			Leakage Tests	3.7.2	G													
			Wind Load Tests	1.3.2	G													
			Coatings and Base Metal Tests	1.6.1														
			SD-08 Manufacturer’s Instructions															
			Installation of Wall panels	1.6.1														
			SD-09 Manufacturer’s Field															
			Reports															
			Manufacturer's Field Reports	3.8.1	G													
			SD-11 Closeout Submittals															
			Warranty	1.9	G													
			Maintenance Instructions	1.6.1														
			20 year 'No Dollar Limit' warranty	1.9.1	G													
			for labor and material															
			Wall panels	1.6.1														
			Sealants and Calking															

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		07 54 19	SD-02 Shop Drawings															
			Detail Drawings	1.8.4	G													
			SD-03 Product Data															
			TPO Roofing Membrane	3.2.2	G													
			Bonding Adhesive	2.1.1	G													
			Flashing	3.2.2.2														
			Membrane Fasteners and Plates	2.1.4														
			Roof Insulation	2.1.7	G													
			Water Cutoffs	3.3.1														
			Information Card	2.1	G													
			SD-05 Design Data															
			Wind uplift calculations	1.2.3	G													
			SD-07 Certificates															
			Qualifications of Applicator	1.4.1	G													
			Wind Uplift Resistance	1.2.3	G													
			Fire Resistance	1.2.2	G													
			warranty	1.8	G													
			SD-08 Manufacturer’s Instructions															
			Application Method	3.2	G													
			Membrane Flashing	2.1.3														
			Perimeter Attachment	3.2.4														
			Auxiliary Fasteners	2.1.4.2														
			cold weather	1.5.2														
			SD-10 Operation and Maintenance															
			Data															

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		07 54 19	Instructions to Government	3.5														
			Personnel															
			SD-11 Closeout Submittals															
			TPO Roofing Membrane	3.2.2														
			Bonding Adhesive	2.1.1														
		07 60 00	SD-02 Shop Drawings															
			Covering on flat, sloped, or	3.1.22	G													
			curved surfaces															
			Gutters	3.1.16	G													
			Downspouts	3.1.17	G													
			Expansion joints	3.1.23	G													
			Splash pans	3.1.21	G													
			Flashing for roof drains	3.1.18	G													
			Base flashing	3.1.11	G													
			Counterflashing	3.1.12	G													
			Flashing at roof penetrations	3.1.24	G													
			Reglets	3.1.13	G													
			Scuppers	3.1.19	G													
			Copings	3.1.26	G													
			Drip edge	3.1.15	G													
			Conductor heads	3.1.20														
			SD-11 Closeout Submittals															
			Quality Control Plan	3.5														
		07 61 14.00 20	SD-02 Shop Drawings															
			Roofing	1.2.5	G													
			SD-03 Product Data															

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		07 61 14.00 20	Roofing panels	2.1	G													
			Attachment clips	2.3														
			Closures	2.4.1														
			Accessories	2.4														
			Fasteners	2.4.2														
			Sealants	2.4.3	G													
			Insulation	2.5														
			warranty	1.7	G													
			SD-04 Samples															
			panel	2.1														
			Accessories	2.4														
			Sealants	2.4.3														
			Intermediate Support	2.2														
			SD-05 Design Data															
			Design calculations	1.5	G													
			SD-06 Test Reports															
			Field Inspection	3.6	G													
			Structural performance	1.3.3	G													
			Finish	1.6.6														
			SD-07 Certificates															
			Manufacturer's Technical	1.6.3	G													
			Representative															
			Installer's Qualifications	1.6.4														
			SD-08 Manufacturer's Instructions															
			Installation	3.3	G													
			SD-11 Closeout Submittals															

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		07 61 14.00 20	Information card	3.8	G													
			Roofing Panels	2.1														
			Sealants	2.4.3														
		07 84 00	SD-02 Shop Drawings															
			Firestopping Materials	2.1														
			SD-07 Certificates															
			Firestopping Materials	2.1														
			Installer Qualifications	1.4														
		07 92 00	SD-03 Product Data															
			Sealants	2.1	G													
			Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
			SD-07 Certificates															
			Sealant	3.3.6														
			SD-11 Closeout Submittals															
			Sealant	3.3.6														
			Primers	2.2														
		08 11 13	SD-03 Product Data															
			Standard Steel Doors	2.1	G													
			Heavy Duty Doors	2.1.1.1	G													
			Fire and Smoke Doors and	2.6	G													
			Frames															
			Accessories	2.3														
			Weatherstripping	2.7														
			Standard Steel Frames	2.5	G													

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		08 11 13	Welded Frames	2.5.1	G													
		08 11 16	SD-08 Manufacturer's Instructions															
			Doors and frames	2.1														
		08 14 00	SD-03 Product Data															
			Doors	2.1	G													
			Accessories	2.2														
			Preservative Treatment															
			Adhesives															
			Finishes	2.3.5														
			Water-resistant sealer	2.3.6														
			warranty	1.4														
			SD-04 Samples															
			Doors	2.1														
			SD-07 Certificates															
			Forest Stewardship Council	1.5.2														
			(FSC) Certification															
			SD-11 Closeout Submittals															
			Water-resistant sealer	2.3.6														
			Preservation Treatment															
			Finishes	2.3.5														
			Doors	2.1														
			Certified Wood	1.5.1														
		08 33 23	SD-02 Shop Drawings															
			Overhead Coiling Doors	2.1														
			Counterbalancing Mechanism	1.6														
			Counterbalancing Mechanism	2.3														

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		08 33 23	Manual Door Operators															
			Electric Door Operators	1.6														
			Electric Door Operators	2.4														
			Bottom Bar															
			Guides	1.5														
			Mounting Brackets	2.3.1														
			Overhead Drum	2.1.6														
			Hood	1.6														
			Painting	1.6														
			Installation Drawings	1.5														
			SD-03 Product Data															
			Overhead Coiling Doors	2.1														
			Hardware	2.2														
			Counterbalancing Mechanism	1.6														
			Counterbalancing Mechanism	2.3														
			Manual Door Operators															
			Electric Door Operators	1.6														
			Electric Door Operators	2.4														
			Fire-Rated Door Assembly	2.5														
			SD-05 Design Data															
			Overhead Coiling Doors	2.1														
			Hardware	2.2														
			Counterbalancing Mechanism	1.6														
			Counterbalancing Mechanism	2.3														
			Manual Door Operators															
			Electric Door Operators	1.6														

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		08 33 23	Electric Door Operators	2.4														
			Fire-Rated Door	1.2														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.5														
			Manuals															
			Overhead Coiling Door	1.6														
			Assemblies															
			Materials	1.6														
			Devices	1.6														
			Procedures	1.6														
			Manufacture's Brochures	1.6														
			Parts Lists	1.6														
			Cleaning	3.3.2														
		08 41 13	SD-02 Shop Drawings															
			Shop drawings	2.4.1	G													
			SD-06 Test Reports															
			Certified Test Reports	1.4.1.2														
			SD-07 Certificates															
			Manufacturer's Product Warranty	1.4.1.2	G													
		08 44 00	SD-02 Shop Drawings															
			Shop Drawings	3.3	G													
			SD-03 Product Data															
			Installation methods															
			Maintenance instructions															
			SD-06 Test Reports															

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		08 44 00	Flame spread and smoke															
			development															
			Burn extent															
			Color change															
			Abrasion & Erosion Resistance															
			Impact stregth, exterior face															
			sheets															
			Accelerated aging															
			Bond tensile strength															
			Bond shear strength															
			Beam bending strength															
			Insulating U-factor		G													
			Self-ignition															
			Class A burning brand															
			Air infiltration															
			Water penetration															
			Uniform load deflection															
			Concentrated and Impact															
			Certification authorization under															
			the NFRC PCP															
			SD-11 Closeout Submittals															
			WARRANTY	1.6	G													
			Documentation															
		08 51 13.00 40	SD-03 Product Data															
			Fixed Windows	2.1	G													
		08 62 00	SD-02 Shop Drawings															

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		08 62 00	Shop Drawings	3.2	G													
			SD-03 Product Data															
			Tubular Daylighting Devices		G													
			Warranty	1.6														
			SD-06 Test Reports															
			Test Reports															
			SD-07 Certificates															
			Daylighting Devices															
			Qualifications	1.4														
		08 71 00	SD-02 Shop Drawings															
			Hardware schedule	1.3	G													
			Keying system		G													
			SD-03 Product Data															
			Hardware items	2.3														
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G													
			SD-11 Closeout Submittals															
			Key Bitting	1.4	G													
		08 81 00	SD-03 Product Data															
			Insulating Glass	2.2	G													
			Glazing Accessories	1.3														
			Local/Regional Materials		G													
			Sealants	2.3.3	G													

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		08 81 00	SD-04 Samples															
			Insulating Glass	2.2	G													
			SD-07 Certificates															
			Insulating Glass	2.2														
			SD-08 Manufacturer’s Instructions															
			Setting and sealing materials	2.3														
			Glass setting	3.2														
			SD-11 Closeout Submittals															
			Local/Regional Materials		G													
			Sealant	2.3.3.1														
		08 91 00	SD-02 Shop Drawings															
			Wall louvers	1.4	G													
			SD-03 Product Data															
			Metal Wall Louvers	2.2	G													
			SD-04 Samples															
			Wall louvers	1.4														
		09 06 90	SD-04 Samples															
			Color Schedule	2.2	G													
		09 22 00	SD-02 Shop Drawings															
			Metal support systems	2.1														
		09 29 00	SD-03 Product Data															
			Cementitious backer units	2.1.5	G													
			Glass Mat Water-Resistant	2.1.4	G													
			Gypsum Tile Backing Board															
			Water-Resistant Gypsum	2.1.3	G													
			Backing Board															

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		09 29 00	Accessories	2.1.10														
			Gypsum Board	2.1.1	G													
			Adhesives	2.1.8														
			Joint Treatment Materials	2.1.6														
			Local/Regional Materials	1.5.1	G													
			SD-07 Certificates															
			Asbestos Free Materials	2.1	G													
			SD-08 Manufacturer’s Instructions															
			Material Safety Data Sheets	2.1														
			SD-10 Operation and Maintenance															
			Data															
			Manufacturer maintenance	2.1														
			instructions															
			Waste Management	3.8	G													
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.5.1	G													
			Gypsum Board	2.1.1														
			Adhesives	2.1.8														
		09 30 00	SD-03 Product Data															
			Local/Regional Materials	1.2.2	G													
			Environmental Data	1.2.3	G													
			Tile	2.1	G(LEED													
			Setting-Bed	2.2	G													
			Mortar, Grout, and Adhesive	2.4	G													
			Reinforcing Wire Fabric	2.2.6														
			SD-04 Samples															

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		09 30 00	Tile	2.1	G													
			Accessories	2.1.2														
			Marble Thresholds	2.5														
			Grout	2.4	G													
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.2.2														
			Tile	2.1														
			Reinforcing Wire Fabric	2.2.6														
			Adhesives	2.4														
		09 51 00	SD-02 Shop Drawings															
			Design Drawings	1.2	G													
			SD-03 Product Data															
			Ceiling Units	2.1	G													
			Certification (LEED)		G													
			Suspension System	2.2	G													
			SD-04 Samples															
			Ceiling Units	2.1	G													
			Suspension System	2.2	G													
			SD-06 Test Reports															
			Ceiling Attenuation Class and	1.2.1	G													
			Test															
			SD-07 Certificates															
			Ceiling Units	2.1														
			SD-11 Closeout Submittals															
			Documentation;															
			Adhesives															

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		09 65 00	SD-02 Shop Drawings															
			Resilient Flooring and	2.9														
			Accessories															
			SD-03 Product Data															
			Resilient Flooring and	2.9	G													
			Accessories															
			Adhesives	2.5	G													
			Linoleum Composition Tile	2.1	G													
			Wall Base	2.2	G													
			Stair Treads, Risers and	2.3														
			Stringers															
			SD-04 Samples															
			Resilient Flooring and	2.9	G													
			Accessories															
			SD-06 Test Reports															
			Moisture, Alkalinity and Bond	3.3	G													
			Tests															
			SD-08 Manufacturer’s Instructions															
			Surface Preparation	3.2														
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Resilient Flooring and	2.9														
			Accessories															
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.2.1														

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		09 65 00	Resilient Flooring and	2.9														
			Accessories															
			Adhesives	2.5														
		09 68 00	SD-03 Product Data															
			Carpet	2.1	G													
			Carpet Pads	2.3	G													
			Carpet Moldings	2.4														
			Base	2.5	G													
			Surface Preparation	3.1														
			Installation	3.4														
			Regulatory Requirements	1.3														
			Environmental Data	1.6.2														
			SD-04 Samples															
			Carpet	2.1	G													
			SD-06 Test Reports															
			Moisture and Alkalinity Tests	3.2														
			SD-07 Certificates															
			Carpet	2.1														
			Regulatory Requirements	1.3														
			SD-10 Operation and Maintenance															
			Data															
			Carpet	2.1	G													
			Cleaning and Protection	3.5														
			Operational Service	1.9														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.6.1														

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		09 68 00	Carpet	2.1														
			Carpet	2.1														
			Carpet Pads	2.3														
			Carpet Pads	2.3														
			Adhesives and Concrete Primer	2.6														
		09 90 00	SD-03 Product Data															
			Coatings	1.11.4.3	G													
			Local/Regional Materials	1.8.1	G													
			Manufacturer's technical data	1.4.8	G													
			sheets															
			SD-04 Samples															
			Color	1.10	G													
			SD-08 Manufacturer’s Instructions															
			Mixing	3.6.2														
			Manufacturer's Material Safety	1.6.2														
			Data Sheets															
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.8.1														
			Materials	1.6.2														
		10 21 13	SD-02 Shop Drawings															
			Fabrication Drawings	1.2														
			Installation Drawings	3.2	G													
			SD-03 Product Data															
			Toilet Partition System		G													
			Cleaning and Maintenance	1.2														
			Instructions															

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		10 21 13	Color and Finishes															
			Galvanized Steel Sheet															
			Sound Deadening Cores															
			Partition Panels and Doors															
			Anchoring Devices and	2.1.1														
			Fasteners															
			Hardware and Fittings	2.1.3														
			Brackets	2.1.2														
			Door Hardware	2.1.4														
			Floor-Anchored Partitions															
			Overhead-Braced Partitions															
			Local/Regional Materials															
			Environmental Data	1.2.1.2														
			Toilet Enclosure															
			Urinal Screens	2.2.2														
			SD-04 Samples															
			Colors and Finishes	2.7	G													
			Partition Panels															
			Hardware and Fittings	2.1.3														
			Anchoring Devices and	2.1.1														
			Fasteners															
			SD-07 Certificates															
			Certification															
			SD-10 Operation and Maintenance															
			Data															
			Waste Management Plan	3.7														

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		10 21 13	Plastic Identification	1.2.2														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.2.1.1														
			Documentation															
			Toilet Enclosures	2.2.1														
			Urinal Screens	2.2.2														
		10 28 13	SD-03 Product Data															
			Finishes	2.1.2	G													
			Accessory Items	2.2	G													
			SD-04 Samples															
			Finishes	2.1.2														
			Accessory Items	2.2														
			SD-07 Certificates															
			Accessory Items	2.2														
			SD-11 Closeout Submittals															
			Local/Regional Materials															
			Toilet															
		10 44 16	SD-01 Preconstruction Submittals															
			Manufacturer's Data	2.1														
			SD-03 Product Data															
			Fire Extinguishers	2.1	G													
			Accessories	2.4														
			Cabinets	2.5	G													
			Replacement Parts	3.2.1														
			SD-07 Certificates															
			Fire Extinguishers	2.1														

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		10 44 16	Manufacturer's Warranty with	2.1														
			Inspection Tag															
		10 51 13	SD-03 Product Data															
			Cleaning and Maintenance	1.2														
			Instructions															
			Material	2.2														
			Handles	2.3.3														
			Locker Components	2.3														
			Assembly	3.1														
			Environmental Data	1.2.1.2														
			Lockers	2.1	G													
			Local/Regional Materials		G													
			SD-04 Samples															
			Colors and Finishes	2.2.2	G													
			SD-07 Certificates															
			Warranty	1.6														
			SD-10 Operation and Maintenance															
			Data															
			Plastic Identification	1.2.2														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.2.1.1														
			Documentation															
			Lockers	2.1														
		12 31 00	SD-02 Shop Drawings															
			fabrication	2.3	G													
			Installation Drawings	3.1	G													

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		12 31 00	SD-03 Product Data															
			Cabinets	2.6														
			Corrosion-Resistant Steel	2.2														
			Fasteners	2.2														
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.5														
			SD-04 Samples															
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.5														
			Manufacturer's Standard Color	2.1	G													
			Charts															
			SD-07 Certificates															
			Corrosion-Resistant Steel	2.2														
			Fasteners	2.2														
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.5														
			SD-08 Manufacturer's Instructions															
			Manufacturer's Instructions	2.1														
		12 36 00	SD-02 Shop Drawings															
			Fabrication	2.3	G													
			Installation drawings	3.1														
			SD-03 Product Data															
			Solid Surface Countertops and	2.3.1	G													
			Backsplashes															
			Adhesives	2.5.1	G													
			Service Fixtures	2.2														

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		12 36 00	Accessories and Hardware	2.5														
			SD-04 Samples															
			Countertop	2.3	G													
			Backsplash,	2.3	G													
			Accessories and Hardware	2.5														
			Manufacturer's Standard Color	2.1														
			Charts															
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	2.1														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.3.1														
			Solid Surface Countertops and	2.3.1														
			Backsplashes															
			Service Fixtures	2.2														
			Accessories and Hardware	2.5														
			Adhesives	2.5.1														
			Sealants	2.5.2														
		12 48 13.13	SD-03 Product Data															
			Entrance Mats	2.2.1	G													
			recycled material content	2.1														
			protective flooring materials	2.1														
			Adhesive		G													
			SD-11 Closeout Submittals															
			Local/Regional Materials															
			Entrance Mats	2.2.1														
			Adhesives															

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		21 13 13.00 10	SD-02 Shop Drawings															
			Shop Drawings	1.4.3	G													
			As-Built Drawings	3.9	G													
			SD-03 Product Data															
			Fire Protection Related	1.4.1														
			Submittals															
			Materials and Equipment	2.3	G													
			Spare Parts	1.6														
			Preliminary Tests	3.8	G													
			Final Acceptance Test	3.9	G													
			Onsite Training	3.10	G													
			Fire Protection Specialist	1.4.1	G													
			Sprinkler System Installer	1.4.2	G													
			SD-05 Design Data															
			Sway Bracing	1.4.3	G													
			Hydraulic Calculations	1.2.1.3	G													
			SD-06 Test Reports															
			Preliminary Test Report	3.9	G													
			Final Acceptance Test Report	3.9	G													
			SD-07 Certificates															
			Inspection by Fire Protection	3.3	G													
			Specialist															
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.10														
			Instructions															

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		22 00 00	SD-02 Shop Drawings															
			Plumbing System	3.9.1	G													
			SD-03 Product Data															
			Fixtures	2.4														
			Flush valve water closets	2.4.3														
			Flush valve urinals Wheelchair															
			flush valve urinal															
			Wall hung lavatories	2.4.6														
			Countertop lavatories	2.4.7														
			Kitchen sinks	2.4.8														
			Service sinks Lavoratories															
			Automatic controls															
			Drinking-water coolers	2.4.10	G													
			Plastic shower stalls Precast															
			terrazzo shower floors															
			Water heaters	2.8	G													
			Pumps	2.10	G													
			Backflow prevention assemblies	3.9.1.1														
			G Drains															
			Shower Faucets	2.6.2														
			G Traps Compressed air system															
			Welding	1.5.1														
			Vibration-Absorbing Features	3.4	G													
			Plumbing System	3.9.1														
			SD-06 Test Reports															
			Tests, Flushing and Disinfection	3.9														

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		22 00 00	Test of Backflow Prevention	3.9.1.1	G													
			Assemblies															
			SD-07 Certificates															
			Materials and Equipment	1.3														
			Bolts	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.9.1	G													
		22 05 48.00 20	SD-02 Shop Drawings															
			Inertia bases	2.7														
			Machinery bases	2.6														
			Platforms	2.6														
			Rails	2.6														
			Saddles	2.6														
			SD-03 Product Data															
			Isolators	2.3														
			Flexible connectors	2.8														
			Flexible duct connectors	2.9														
			Pipe guides	2.11														
			Seismic snubbers	2.10														
			Vertical stops	3.1.3														
			Thrust restraints	2.12														
			Inertia bases	2.7														
			Machinery bases	2.6														
			Machinery foundations and	3.1.13														
			subbases															

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		22 05 48.00 20	Platforms	2.6														
			Rails	2.6														
			Saddles	2.6														
			Machinery manufacturer's sound	1.4.2														
			data															
			SD-05 Design Data															
			Inertia bases	2.7														
			Machinery bases	2.6														
			Platforms	2.6														
			Rails	2.6														
			Saddles	2.6														
			machinery	1.4.3														
			machinery over 300 pounds	1.4.4														
			SD-06 Test Reports															
			Seismic snubbers	2.10														
			Equipment vibration tests	3.2.3.1														
			Equipment sound level tests	3.2.3.2														
			Protected spring isolators	2.4														
			SD-08 Manufacturer’s Instructions															
			Vibration and noise isolation	3.1.1														
			components															
			Seismic protection components	2.13														
		22 07 19	SD-02 Shop Drawings															
			Installation Drawings	1.6														
			Installation Drawings	3.1														
			SD-03 Product Data															

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		22 07 19	Adhesives	Part 2	G													
			Coatings	Part 2	G													
			Insulating Cement	Part 2														
			Insulation Materials	Part 2	G													
			Jacketing	Part 2														
			Tape	Part 2														
			SD-07 Certificates															
			Recycled Materials	1.5														
			Recycled Materials	1.5														
			SD-08 Manufacturer's Instructions															
			Installation Manual	1.6														
			Installation Manual	3.1														
		22 15 09	SD-01 Preconstruction Submittals															
			Pre-Qualification Statement	1.3														
			SD-03 Product Data															
			Demineralized Water	2.1														
			Drying or Preservation Gas	2.2														
			Filter Discs	2.3														
			Nitric Acid	2.4														
			Citric Acid	2.5														
			Muriatic Acid	2.6														
			Hydrofluoric Acid	2.7														
			Normal - Propyl Bromide	2.8														
			Tape	2.9														
			Polyethylene Film	2.10														

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		22 15 09	Low Water-Vapor Transmission	2.11														
			Film															
			Aluminum Foil	2.12														
			SD-04 Samples															
			Polyethylene Film	2.10														
			Certification Tags	2.13														
			Low Water-Vapor Transmission	2.11														
			Film															
			SD-06 Test Reports															
			Quality Assurance Tests	3.2														
			Inspection Records	1.5														
			SD-07 Certificates															
			Inspection Facilities and Services	1.5														
			Contractor's Procedures	1.5														
		22 15 14	SD-02 Shop Drawings															
			Installation Drawings	1.6														
			SD-03 Product Data															
			Equipment and Performance	1.4														
			Data															
			Underground Piping Materials	2.1														
			Aboveground Piping Materials	2.2														
			Piping Specialties	2.3														
			Supporting Elements	2.7														
			Air Compressors	2.4														
			Valves	2.5														
			Accessories	3.2.1														

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		22 15 14	Miscellaneous Materials	2.6														
			Vibration Isolation	3.2.6														
			SD-05 Design Data															
			Design Analysis and Calculations	1.4														
			Flow Rates	1.4														
			Air Distribution	1.4														
			Pressure Requirements	1.4														
			Insulation Requirements	1.4														
			Equipment and Performance	1.4														
			Data															
			SD-06 Test Reports															
			Hydrostatic Testing	3.3.1														
			Compressed Air Systems Testing	3.3														
			Valve-Operating Tests	3.3.1														
			Drainage Tests	3.3.1														
			Pneumatic Testing	3.3.1														
			SD-07 Certificates															
			Underground Piping Materials	2.1														
			Aboveground Piping Materials	2.2														
			Supporting Elements	2.7														
			Riser Alarm Equipment	1.4														
			Sprinkler Heads	1.4														
			Valves	2.5														
			Miscellaneous Materials	2.6														
			SD-10 Operation and Maintenance															
			Data															

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		22 15 14	Operation and Maintenance	1.5														
			Manuals															
		23 00 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.5	G													
			SD-03 Product Data															
			Insulated Nonmetallic Flexible	2.8.1.1														
			Duct Runouts															
			Duct Connectors	2.8.1.1														
			Duct Access Doors	2.8.2	G													
			Manual Balancing Dampers	2.8.3	G													
			Manual Balancing Dampers	2.8.4	G													
			Automatic Smoke-Fire Dampers	2.8.6														
			Diffusers	2.8.10.1														
			Registers and Grilles	2.8.10.2														
			Louvers	2.8.11														
			Diagrams	1.2.1.2	G													
			SD-06 Test Reports															
			Performance Tests	3.12	G													
			Damper Acceptance Test	3.10	G													
			SD-07 Certificates															
			Bolts	1.4.1														
			Certification	1.4.6														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Installation	3.2														
			Instructions															

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		23 00 00	Operation and Maintenance	3.14.2														
			Training															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.14.1														
			Manuals															
			Manual Balancing Dampers	2.8.3														
			Manual Balancing Dampers	2.8.4														
			Automatic Smoke-Fire Dampers	2.8.6	G													
			Centrifugal Type Power Roof	2.9.1.1	G													
			Ventilators															
		23 05 15	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	1.2	G													
			Lists															
			SD-02 Shop Drawings															
			Record Drawings	1.2	G													
			Connection Diagrams	1.2	G													
			Coordination Drawings	1.2	G													
			Fabrication Drawings	1.2	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Pipe and Fittings	2.2	G													
			Piping Specialties	2.3	G													
			Valves	2.4	G													
			Miscellaneous Materials	2.5	G													
			Supporting Elements	2.6	G													

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		23 05 15	Equipment Foundation Data	1.2	G													
			SD-04 Samples															
			Manufacturer's Standard Color	1.2	G													
			Charts															
			SD-05 Design Data															
			Pipe and Fittings	2.2	G													
			Piping Specialties	2.3	G													
			Valves	2.4	G													
			SD-06 Test Reports															
			Hydrostatic Tests	3.1														
			Air Tests	3.1														
			Valve-Operating Tests	3.1														
			System Operation Tests	3.1														
			SD-07 Certificates															
			Listing of Product Installations	1.2														
			Records of Existing Conditions	1.2														
			Surface Resistance	3.1														
			Shear and Tensile Strengths	3.1														
			Temperature Ratings	3.1														
			Bending Tests	3.1														
			Flattening Tests	3.1														
			Transverse Guided Weld Bend	3.1														
			Tests															
			SD-10 Operation and Maintenance															
			Data															

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		23 05 15	Operation and Maintenance	3.11														
			Manuals															
		23 05 48	SD-02 Shop Drawings															
			Installation Drawings	1.2	G													
			Outline Drawings	1.2	G													
			SD-03 Product Data															
			Equipment and Performance	1.2	G													
			Data															
			Isolators	1.2														
			SD-06 Test Reports															
			Type of Isolator	2.1														
			Allowable Deflection	2.1														
			Measured Deflection	2.1														
		23 05 93	SD-01 Preconstruction Submittals															
			TAB Firm	1.5.4.1	G													
			TAB team assistants	1.2	G													
			TAB team engineer	1.2	G													
			TAB Specialist	1.5.4.2	G													
			TAB team field leader	1.2	G													
			SD-02 Shop Drawings															
			TAB Schematic Drawings and	1.3.3	G													
			Report Forms															
			SD-03 Product Data															
			Equipment and Performance	1.3	G													
			Data															
			TAB Related HVAC Submittals	1.5.4.4	G													

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		23 05 93	TAB Procedures	1.5.2	G													
			Calibration	1.5.2	G													
			Systems Readiness Check	1.3.3	G													
			TAB Execution	1.5.5	G													
			TAB Verification	1.5.5.3	G													
			SD-06 Test Reports															
			Design review report	1.3.3	G													
			Design review report	1.6.1.1	G													
			Pre-Final DALT report	1.5.3	G													
			Pre-Final DALT report	1.6.1	G													
			Pre-Final DALT report	3.3.5	G													
			Final DALT report	1.5.3	G													
			Final DALT report	1.6.1	G													
			Final DALT report	3.3.8	G													
			TAB report	1.5.6.2	G													
			SD-07 Certificates															
			Independent TAB agency and	1.5.1	G													
			personnel qualifications															
			Independent TAB agency and	1.5.1	G													
			personnel qualifications															
			Advance notice of Pre-Final	3.3.2	G													
			DALT field work															
			TAB Firm	1.5.4.1	G													
			DALT and TAB Submittal and	1.6.1	G													
			Work Schedule															
			Design review report	1.3.3	G													

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		23 05 93	Design review report	1.6.1.1	G													
			Pre-field DALT preliminary	1.6.1.2	G													
			notification															
			Pre-field TAB engineering report	1.6.1.3	G													
			Advanced notice for TAB field	1.6.1	G													
			work															
			Prerequisite HVAC Work Check	1.6.1	G													
			Out List															
		23 07 00	SD-03 Product Data															
			Pipe Insulation Systems	2.3	G													
			Pipe Insulation Systems	3.2	G													
			Duct Insulation Systems	3.3	G													
			Equipment Insulation Systems	3.4	G													
			SD-08 Manufacturer's Instructions															
			Pipe Insulation Systems	2.3	G													
			Pipe Insulation Systems	3.2	G													
			Duct Insulation Systems	3.3	G													
			Equipment Insulation Systems	3.4	G													
		23 08 00.00 10	SD-02 Shop Drawings															
			Commissioning Plan	1.5.2.2	G													
			SD-06 Test Reports															
			Commissioning Report	3.3	G													
			SD-07 Certificates															
			Commissioning Firm	1.5.1	G													
			Commissioning Specialist	1.5.2	G													
		23 09 23.13 20	SD-02 Shop Drawings															

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		23 09 23.13 20	Control system drawings title	1.4.1.1	G													
			sheet															
			List of I/O Points	1.4.1.2	G													
			Control System Components List	1.4.1.3	G													
			Control system schematics	1.4.1.4	G													
			HVAC Equipment Electrical	1.4.1.5	G													
			Ladder diagrams															
			Component wiring diagrams	1.4.1.6	G													
			Terminal strip diagrams	1.4.1.7	G													
			BACnet communication	1.4.1.8	G													
			architecture schematic															
			SD-03 Product Data															
			Direct Digital Controllers	2.1.1	G													
			BACnet Gateways	2.1.1.13	G													
			BACnet Protocol Analyzer	2.1.5	G													
			DDC Software	2.1.2	G													
			BACnet Operator Workstation	2.1.3	G													
			BACnet Operator Workstation	2.1.3.3	G													
			DDC Software															
			Notebook Computer	2.1.4	G													
			Sensors and Input Hardware	2.2	G													
			Output Hardware	2.3	G													
			Surge and transient protection	2.4.1	G													
			Indicators	2.6	G													
			Duct smoke detectors	2.5.1	G													
			SD-05 Design Data															

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		23 09 23.13 20	Performance Verification Testing	3.4.2	G													
			Plan															
			Pre-Performance Verification	3.4.4	G													
			Testing Checklist															
			SD-06 Test Reports															
			Performance Verification Testing	3.4.11	G													
			Report															
			SD-07 Certificates															
			Contractor's Qualifications	1.6.6	G													
			SD-09 Manufacturer's Field															
			Reports															
			Pre-PVT Checklist	3.4.1	G													
			SD-10 Operation and Maintenance															
			Data															
			BACnet Direct Digital Control	1.4	G													
			Systems															
			Controls System Operators	3.3	G													
			Manuals															
			SD-11 Closeout Submittals															
			Training documentation	3.5.1	G													
		23 11 25	SD-02 Shop Drawings															
			Gas Piping System	1.4.3	G													
			Gas Piping System	2.2	G													
			Gas Piping System	3.3	G													
			SD-03 Product Data															
			Pipe and Fittings	1.5	G													

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		23 11 25	Gas equipment connectors	1.4.3	G													
			Gas Piping System	1.4.3	G													
			Gas Piping System	2.2	G													
			Gas Piping System	3.3	G													
			Pipe Coating Materials and	2.1	G													
			application procedures															
			Pressure regulators	2.6	G													
			Risers	2.4	G													
			Transition fittings	2.2.12	G													
			Valves	2.3	G													
			Valve box	2.6	G													
			Warning and identification tape	2.2.8	G													
			SD-06 Test Reports															
			Testing	3.17	G													
			Pressure Tests	3.17.1	G													
			Pressure Tests for Liquified	3.17.2														
			Petroleum Gas															
			Test With Gas	3.17.3	G													
			SD-07 Certificates															
			Welders procedures and	1.4.1	G													
			qualifications															
			assigned number, letter, or	1.4.1														
			symbol															
			SD-08 Manufacturer's Instructions															
			PE pipe and fittings	1.4.2	G													

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		23 11 25	pipe coating materials and	2.1														
			application procedures															
			SD-10 Operation and Maintenance															
			Data															
			Gas facility system and	1.2.1														
			equipment operation															
			Gas facility system maintenance	1.2.2														
			Gas facility equipment	1.2.3	G													
			maintenance															
		23 23 00	SD-02 Shop Drawings															
			Refrigerant Piping System	2.3	G													
			SD-03 Product Data															
			Refrigerant Piping System	2.3	G													
			Spare Parts	1.5.2														
			Refrigerant Piping Tests	3.4	G													
			Demonstrations		G													
			Verification of Dimensions	3.1														
			SD-06 Test Reports															
			Refrigerant Piping Tests	3.4														
			SD-07 Certificates															
			Service Organization	2.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Maintenance	1.5														
			Operation and Maintenance	3.2.4.2														
			Manuals															

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		23 25 00	SD-03 Product Data															
			Water Treatment System		G													
			Water Analysis	2.3	G													
			Field Instructions															
			Tests	3.4	G													
			Demonstrations		G													
			SD-10 Operation and Maintenance															
			Data															
			Water Treatment System															
		23 35 19.00 20	SD-02 Shop Drawings															
			Industrial ventilation and exhaust	1.2.3	G													
			systems															
			SD-03 Product Data															
			Fans	2.1	G													
			Dampers	3.1.1	G													
			Flexible connectors	2.4.3														
			Flexible duct	2.4.4	G													
			Gaskets	2.4.5														
			Protective coating materials	2.4.6														
			Sealants	2.4.7														
			Access ports	2.5.1	G													
			Blast gates	2.5.2	G													
			Vibration isolators	2.6.5	G													
			Ductwork, Dust and Fume	2.7														
			Collection															
			Welding fume exhaust system	2.8	G													

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		23 35 19.00 20	Local/Regional Materials	1.8.1														
			SD-07 Certificates															
			Welding procedures	1.4.2	G													
			Welding test agenda	3.1.6	G													
			Welding test procedures	1.4.2	G													
			Welders' identification	1.4.1	G													
			SD-06 Test Reports															
			Fan tests	2.1.1	G													
			start-up tests	1.2.4	G													
			Sound level tests	3.2.6	G													
			SD-10 Operation and Maintenance															
			Data															
			Fans	2.1	G													
			Welding fume exhaust system	2.8	G													
			Industrial ventilation and exhaust	1.2.3	G													
			systems															
			SD-11 Closeout Submittals															
			Posted operating instructions	1.6														
		23 52 00	SD-02 Shop Drawings															
			Installation	2.2.1	G													
			SD-03 Product Data															
			Materials and Equipment	2.1.1														
			Spare Parts	1.5														
			Spare Parts	1.5														
			Heating System Tests	3.3														
			Fuel System Tests	3.6														

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		23 52 00	Welding	1.3														
			Qualifications	3.3														
			Field Instructions	3.5														
			Tests	3.3														
			SD-06 Test Reports															
			Heating System Tests	3.3	G													
			Fuel System Tests	3.6	G													
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.5														
			Instructions															
		23 64 10	SD-03 Product Data															
			Water Chiller	2.4	G													
			Water Chiller	2.4	G													
			Water Chiller	3.1	G													
			Water Chiller	3.1	G													
			Water Chiller	3.4.1	G													
			Water Chiller	3.4.1	G													
			Manufacturer's Multi-Year	1.7														
			Compressor Warranty															
			System Performance Tests	3.5														
			Demonstrations	3.6														
			SD-06 Test Reports															
			Field Acceptance Testing	3.4														
			Water Chiller	2.4														
			Water Chiller	3.1														

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		23 64 10	Water Chiller	3.4.1														
			System Performance Tests	3.5														
			SD-07 Certificates															
			Refrigeration System	3.1.1	G													
			SD-08 Manufacturer’s Instructions															
			Water Chiller	2.4	G													
			Water Chiller	3.1	G													
			Water Chiller	3.4.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.6	G													
			Manuals															
		23 76 00.00 10	SD-02 Shop Drawings															
			Evaporative Cooling Systems	2.1.1	G													
			Installation Drawings	1.3.2	G													
			SD-03 Product Data															
			Equipment	3.2	G													
			Test Procedures	1.3.2	G													
			Installation	3.2	G													
			Manufacturer's Representative	1.3.2														
			Service Organization	1.3.3														
			Performance Tests	3.7														
			Training Course	3.5														
			SD-06 Test Reports															
			Testing, Adjusting, and Balancing	3.6	G													
			SD-07 Certificates															

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		23 76 00.00 10	Installation Drawings	1.3.2														
			SD-10 Operation and Maintenance															
			Data															
			Evaporative Cooling Systems	2.1.1	G													
		23 82 02.00 10	SD-02 Shop Drawings															
			Drawings	1.4														
			SD-03 Product Data															
			Materials and Equipment	2.1.1														
			Spare Parts	1.6														
			Posted Instructions	3.4														
			Verification of Dimensions	3.1														
			Coil Corrosion Protection															
			System Performance Tests	3.6														
			Demonstrations	3.4	G													
			SD-06 Test Reports															
			Refrigerant Tests, Charging, and	3.5	G													
			Start-Up															
			System Performance Tests	3.6	G													
			SD-07 Certificates															
			Materials and Equipment	2.1.1														
			Service Organization	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.4														
			Manuals															
		26 05 00.00 40	SD-03 Product Data															

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		26 05 00.00 40	Conduits, Raceway sand Fittings	3.1	G													
			Wire and Cable	2.2	G													
			Splices and Connectors	2.3	G													
			Switches	2.4	G													
			Receptacles	2.1.7	G													
			Receptacles	2.5	G													
			Receptacles	3.4.1	G													
			Outlets, Outlet Boxes, and Pull	2.6	G													
			Boxes															
			Circuit Breakers	2.8	G													
			Lamps and Lighting Fixtures	2.9	G													
			Lamps and Lighting Fixtures	3.6	G													
			Spare Parts	1.3	G													
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	1.5														
		26 05 13.00 40	SD-03 Product Data															
			Single-Conductor Shielded	2.3	G													
			Cables															
			SD-08 Manufacturer’s Instructions															
			Medium-Voltage Power Cables	1.6	G													
		26 05 48.00 10	SD-02 Shop Drawings															
			Lighting Fixtures in Buildings	3.2	G													
			Panelboards		G													
		26 08 00	SD-06 Test Reports															
			Acceptance tests and inspections	3.1	G													
			SD-07 Certificates															

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		26 08 00	Qualifications	1.4.1	G													
			Acceptance test and inspections	1.4.3	G													
			procedure															
		26 12 19.10	SD-02 Shop Drawings															
			Pad-mounted transformer	1.5.1	G													
			drawings															
			SD-06 Test Reports															
			Acceptance checks and tests	3.7.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Transformer(s)	1.6.1	G													
			SD-11 Closeout Submittals															
			Transformer test schedule	2.7.1	G													
		26 13 00.00 20	SD-02 Shop Drawings															
			Switchgear Drawings	1.5.1	G													
			SD-03 Product Data															
			SF6 Insulated Pad-mounted	2.1	G													
			Switchgear															
			Insulated High-Voltage	2.2	G													
			Connectors															
			SD-06 Test Reports															
			Acceptance Checks and Tests	3.4.1	G													
			SD-09 Manufacturer’s Field															
			Reports															
			Switchgear design and	2.4.1	G													
			production tests															

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		26 13 00.00 20	SD-10 Operation and Maintenance															
			Data															
			SF6 Insulated Pad-mounted	1.6.1	G													
			Switchgear Operation and															
			Maintenance															
		26 18 23.00 40	SD-03 Product Data															
			Equipment and Performance	1.2														
			Data															
			Surge Arresters	2.2	G													
			Mounting Brackets	2.3	G													
			SD-08 Manufacturer's Instructions															
			Installation Instructions	3.1.1	G													
			Surge Arresters	2.2	G													
			SD-10 Operation and Maintenance															
			Data															
			O & M Manuals	2.2.1	G													
			Surge Arresters	2.2	G													
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.10	G													
			Transformers	2.12	G													
			SD-03 Product Data															
			Receptacles	2.9	G													
			Circuit breakers	2.10.3	G													
			Switches	2.7	G													
			Transformers	2.12	G													
			Enclosed circuit breakers	2.11	G													

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		26 20 00	Motor controllers	2.13	G													
			Metering		G													
			SD-06 Test Reports															
			600-volt wiring test	3.5.2	G													
			Grounding system test	3.5.4	G													
			Ground-fault receptacle test	3.5.3	G													
		26 23 00	SD-02 Shop Drawings															
			Switchboard Drawings	1.5.2	G													
			SD-03 Product Data															
			Switchboard	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Switchboard Operation and	1.6.1	G													
			Maintenance															
			SD-11 Closeout Submittals															
			Assembled Operation and	1.6.2	G													
			Maintenance Manuals															
			Equipment Test Schedule	2.5.1	G													
			Request for Settings	3.5	G													
		26 24 16.00 40	SD-02 Shop Drawings															
			Detail Drawings	1.2	G													
			Outline Drawings	1.2	G													
			SD-08 Manufacturer’s Instructions															
			Panelboards	2.1	G													
		26 29 23	SD-02 Shop Drawings															
			Schematic diagrams	1.5.1	G													

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		26 29 23	Interconnecting diagrams	1.5.2	G													
			Installation drawings	1.5.3	G													
			SD-03 Product Data															
			Variable frequency drives	2.1	G													
			Wires and cables	2.3														
			Equipment schedule	1.5.4														
			SD-06 Test Reports															
			VFD Test	3.2.1														
			Performance Verification Tests	3.2.2														
			Endurance Test	3.2.3														
			SD-08 Manufacturer’s Instructions															
			Installation instructions	1.5.5														
			SD-09 Manufacturer’s Field															
			Reports															
			VFD Factory Test Plan	2.5.1	G													
			Factory test results	1.5.6														
			SD-10 Operation and Maintenance															
			Data															
			Variable frequency drives	2.1														
		26 35 33.00 40	SD-02 Shop Drawings															
			Wiring Diagrams	1.4	G													
			shop drawings		G													
			SD-03 Product Data															
			PV Modules		G													
			Inverters		G													
			Combiner Boxes		G													

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		26 35 33.00 40	Disconnect Switches		G													
			Panelboard		G													
			Mounting Hardware		G													
			Fuses		G													
			Cable		G													
			Connectors		G													
			SD-07 Certificates															
			Qualification of Installer		G													
		26 51 00	SD-03 Product Data															
			LED lighting fixtures	2.1	G													
			Dimmer switch	2.4.2	G													
			Lighting Control Panel		G													
			Photocell switch	2.5	G													
			Exit signs	2.6	G													
			Emergency lighting equipment	2.7	G													
			Occupancy sensors	2.8	G													
			Electronic dimming ballast	2.1.1	G													
			Electronic dimming ballast	3.1.3	G													
			Dimming ballast controls		G													
			Light Level Sensor	2.1.2	G													
			SD-06 Test Reports															
			Operating test	3.3	G													
			SD-10 Operation and Maintenance															
			Data															
			Lighting Control System	1.4.1	G													
			Operational Service	1.8														

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		26 52 00.00 40	SD-03 Product Data															
			Emergency Lighting Egress Units	2.2	G													
			SD-06 Test Reports															
			System Operational Tests	3.2	G													
		26 56 00	SD-03 Product Data															
			Energy Efficiency	1.6.1														
			Luminaires	2.2	G													
			Lamps	2.2.1	G													
			Ballasts		G													
			Lighting contactor	2.3	G													
			Lighting Control Panel		G													
			Photocell switch	2.5	G													
			Steel poles	2.6.1	G													
			Brackets	2.7														
			SD-10 Operation and Maintenance															
			Data															
			Operational Service	1.8														
		28 31 76	SD-02 Shop Drawings															
			Wiring Diagrams	3.1.1	G													
			System Layout	1.4.1	G													
			System Operation	2.3	G													
			Notification Appliances	2.17	G													
			Amplifiers	2.14	G													
			As-Built Drawings	3.5.2														
			SD-03 Product Data															

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		28 31 76	Technical Data And Computer	1.4.2	G													
			Software															
			Fire alarm control panel	1.4.2	G													
			Fire Alarm And Mass Notification	2.12	G													
			Control Panel (FACP/FMCP)															
			Printers	2.15	G													
			Terminal cabinets	3.1.2	G													
			Manual stations	2.16	G													
			Batteries	2.11.1	G													
			Battery chargers	2.11.2	G													
			Smoke sensors	2.9	G													
			Thermal sensors	2.10	G													
			Wiring		G													
			Notification appliances	2.17	G													
			Addressable interface devices	2.7	G													
			Graphic annunciator	2.3.2	G													
			Amplifiers	2.14	G													
			Tone generators	2.14	G													
			Digitalized voice generators	2.14	G													
			Waterflow detectors	2.20	G													
			Tamper switches	2.19	G													
			Remote fire alarm control units	2.13	G													
			SD-05 Design Data															
			System Operation	2.3	G													
			Battery power	2.11.1.2	G													
			SD-06 Test Reports															

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		28 31 76	Field Quality Control	3.5														
			Testing Procedures	3.5.1	G													
			Smoke sensor testing	2.9.4	G													
			SD-07 Certificates															
			Installer	1.6.1.4														
			SD-09 Manufacturer’s Field															
			Reports															
			Mass Notification System	1.6.2.2														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.8	G													
			(O&M) Instructions															
			Instruction of Government	3.6														
			Employees															
		31 23 00.00 20	SD-01 Preconstruction Submittals															
			Shoring and Sheeting Plan	1.7.1	G													
			Dewatering work plan	1.7.2	G													
			SD-06 Test Reports															
			Borrow Site Testing	1.6	G													
			Fill and backfill	3.12.2.1														
			Density tests	3.12.2.2														
			Moisture Content Tests	3.12.2.3														
		32 01 19	SD-03 Product Data															
			Manufacturer's	1.2.2.3	G													
			Recommendations															
			Equipment	1.2														

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		32 01 19	SD-04 Samples															
			Materials	1.4.2	G													
		32 10 00	SD-03 Product Data															
			Local/Regional Materials	1.7.1														
			Albedo	2.1.1														
			SD-05 Design Data															
			mix design	1.4.4	G													
			Asphalt concrete	2.1	G													
			Asphalt cement	1.7.4	G													
			Asphalt cement	1.7.4	G													
			Asphalt cement	2.3.1	G													
			Aggregates	2.2	G													
			Liquid asphalt	2.3.2	G													
			Asphaltic emulsion	2.3.3	G													
			Paint	3.2.8.2	G													
			Reflective media	3.2.8.2	G													
			Traffic signs	2.6	G													
			SD-06 Test Reports															
			Asphalt concrete	2.1														
			SD-07 Certificates															
			mix delivery record	1.4.3														
			Asphalt concrete	2.1														
			Asphalt concrete	2.1														
			Traffic signs	2.6														
		32 11 24	SD-03 Product Data															
			Aggregates	2.1.1														

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		32 11 24	Local/Regional Materials	1.7.1														
			SD-06 Test Reports															
			Gradation	3.7.2.1														
			Gradation	3.7.2.1														
			Bearing ratio	2.1.1														
			Liquid limit	2.1.1														
			Plasticity index	2.1.1														
			Percentage of wear	2.1.1														
			Density	3.7.2.3														
			Density	3.7.2.3														
			Smoothness	3.7.2.2														
			Thickness	3.7.2.5														
		32 13 13.06	SD-03 Product Data															
			Curing materials	2.1.6														
			Admixtures	2.1.4														
			Reinforcement															
			Cementitious Materials	2.1.1														
			Aggregate	2.1.3														
			Local/Regional Materials	1.6.1														
			Albedo	2.2.1														
			SD-04 Samples															
			Field-Constructed Mockup	1.5.4														
			SD-05 Design Data															
			mix design	2.3														
			SD-06 Test Reports															
			Aggregate	2.1.3														

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		32 13 13.06	Concrete slump tests	3.8.2														
			Air content tests	3.8.4														
			Flexural strength tests	3.8.3														
			Cementitious materials	2.1.1														
			Albedo	2.2.1														
			Permeability	2.2.2														
			SD-07 Certificates															
			Ready-mixed concrete plant	1.5.1														
			Batch tickets	1.5.3														
			Cementitious materials	2.1.1														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.6.1														
			Cementitious Materials	2.1.1														
			Aggregate	2.1.3														
			Albedo	2.2.1														
		32 13 15.20	SD-02 Shop Drawings															
			Formwork	1.6.2.1														
			Reinforcing steel	1.6.2.2	G													
			SD-03 Product Data															
			Materials for curing concrete	2.4.6	G													
			Local/Regional Materials	1.8.1	G													
			Local/Regional Materials	1.8.1	G													
			Joint sealants	2.4.8	G													
			Joint filler	2.4.7	G													
			Cement	2.4.1	G													
			Reinforcement	2.5	G													

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		32 13 15.20	Epoxy bonding compound	2.4.9	G													
			Biodegradable Form Release	2.4.10	G													
			Agent															
			Handhole Frames and Covers	2.7														
			SD-05 Design Data															
			mix design	2.3.1	G													
			SD-06 Test Reports															
			Concrete mix design	1.6.4.1	G													
			Fly ash	1.6.4.2														
			Pozzolan	1.6.4.2														
			Ground iron blast-furnace slag	1.6.4.3														
			Aggregates	1.6.4.4														
			Compressive strength tests	3.10.2.3														
			Flexural strength tests	3.10.2.4														
			Air Content	3.10.2.5														
			SD-07 Certificates															
			Form removal schedule	1.6.3.3														
			Biodegradable Form Release	2.4.10														
			Agent															
			VOC Content for form release	1.6.3.4														
			agents and curing compounds															
			Material Safety Data Sheets	1.6.3.5														
			Forest Stewardship Council	1.8.2														
			(FSC) Certification															
		32 16 13	SD-03 Product Data															
			Concrete	2.1														

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		32 16 13	SD-06 Test Reports															
			Field Quality Control	3.8														
		32 93 00	SD-01 Preconstruction Submittals															
			State Landscape Contractor's	1.4.3														
			License															
			Time Restrictions and Planting	1.6														
			Conditions															
			SD-03 Product Data															
			Ground Stakes	2.7.1.2														
			Ground Stakes	2.7.1.2														
			Weed control fabric	1.5.2.4	G													
			Root control barrier	1.5.2.4	G													
			Rock ground cover/boulders		G													
			Staking Material	2.7.1														
			Antidesiccants	2.8														
			Photographs	1.4.4	G													
			SD-04 Samples															
			Rock ground cover/boulders		G													
			SD-06 Test Reports															
			Topsoil composition tests	1.4.1														
			Topsoil composition tests	2.2.3														
			Percolation Test	1.4.5														
			SD-07 Certificates															
			Nursery certifications	1.4.2														
			Nursery certifications	2.1.1														

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		32 93 00	SD-10 Operation and Maintenance															
			Data															
			Plastic Identification															
		33 11 00	SD-03 Product Data															
			Piping Materials	2.1.1														
			Water distribution main	2.1	G													
			Water service line	2.2	G													
			Reduced pressure principle	2.3	G													
			backflow preventer assemblies															
			Turbine Type Meters	2.2.2.12	G													
			Valve boxes	2.1.2.5	G													
			Valve boxes	2.2.2.9	G													
			Service saddle	2.2.2.11	G													
			Tapping sleeves	2.2.2.10	G													
			Pressure Regulator	2.2.2.14	G													
			Insulation	2.2.2.13	G													
			Precst Concrete Vault	2.1.3	G													
			SD-06 Test Reports															
			Disinfection	3.1.5	G													
			SD-07 Certificates															
			Water distribution main	2.1														
			Water service line	2.2														
			Reduced pressure principle	2.3														
			backflow preventer assemblies															
			SD-08 Manufacturer's Instructions															
			Delivery, storage, and handling	1.4														

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		33 11 00	Installation	3.1.1														
			Precst Concrete Vault	2.1.3														
		33 30 00	SD-02 Shop Drawings															
			Precast concrete manhole	2.3.1	G													
			Metal items	2.3.4	G													
			SD-03 Product Data															
			Pipeline materials	2.1														
			SD-06 Test Reports															
			Reports	2.4														
			SD-07 Certificates															
			Portland Cement	2.2.2														
			Gaskets															
		33 40 00	SD-03 Product Data															
			Placing Pipe	3.3														
			Fossil Filter Storm Drain Insert	2.3.5														
			Ball Valve															
			SD-07 Certificates															
			Resin Certification	2.1.1														
			Pipeline Testing	3.7														
			Hydrostatic Test on Watertight	2.6														
			Joints															
			Determination of Density	3.6.5														
			Frame and Cover for Gratings	2.3.4														
		33 71 02.00 20	SD-02 Shop Drawings															
			Precast underground structures	1.4.1	G													
			SD-03 Product Data															

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		33 71 02.00 20	Medium voltage cable	2.5	G													
			Medium voltage cable joints	2.7	G													
			Medium voltage cable	2.6	G													
			terminations															
			Precast concrete structures	2.11.1.1	G													
			Sealing Material	2.11.1.4														
			Pulling-In Irons	3.5.2														
			Manhole frames and covers	2.11.2	G													
			Handhole frames and covers	2.11.3	G													
			Cable supports	2.12	G													
			SD-06 Test Reports															
			Arc-proofing test	2.14.1	G													
			Medium voltage cable	2.14.2	G													
			qualification and production tests															
			Field Acceptance Checks and	3.18.1	G													
			Tests															
			SD-07 Certificates															
			Cable splicer/terminator	1.4.2	G													
			Cable Installer Qualifications	1.4.3	G													
		41 22 23.19	SD-02 Shop Drawings															
			Vertical reciprocating conveyor		G													
			system															
			Complete schematic wiring	1.2.2														
			diagram with description of															
			operation															
			SD-03 Product Data															

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		41 22 23.19	Carriage		G													
			Lift structure		G													
			Hydraulic lifting system	1.2.1	G													
			Safety guarding		G													
			Call stations		G													
			Bi-panel vertical gate		G													
			SD-05 Design Data															
			Structural Design calculations	1.2.1	G													
			Structural and Load Capacity		G													
			calculations															
			SD-10 Operation and Maintenance															
			Data															
			Conveyor with hoist system, all		G													
			components, Data Package 3															
		44 41 13	SD-02 Shop Drawings															
			Equipment Installation	3.3.2	G													
			SD-03 Product Data															
			Water Effeciency															
			Water Budget															
			SD-06 Test Reports															
			Testing	3.6.2														
			SD-10 Operation and Maintenance															
			Data															
			Treatment Plant Installation	3.5	G													