US Army Corps of Engineers

MIDDLE EAST DISTRICT

TETRA TECH

FY11 COMMAND AND CONTROL FACILTY KANDAHAR AIR FIELD, AFGHANISTAN

W2912ER-029-D-0003 Task Order 0025

Technical Specifications

Volume 1 of 3

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Design Complete

March 9, 2012

DESIGN COMPLETE
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

		DATE
VOLUME 1 OF 3		
DIVISION 01- GENERAL REQUIREMENTS		
01 80 00.12 10	TECHNICAL REQUIREMENTS	3/9/12
DIVISION 02- EXISTING CONDITIONS		
02 21 00	TOPOGRAPHIC SURVEY	3/9/12
02 33 00	SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION	3/9/12
DIVISION 03 - CONCRETE		
03 11 13.00 10	STRUCTURAL CAST-IN-PLACE CONCRETE FORMING	3/9/12
03 15 00.00 10	CONCRETE ACCESSORIES	3/9/12
03 20 00.00 10	CONCRETE REINFORCING	3/9/12
03 30 00.00 10	CAST-IN-PLACE CONCRETE	3/9/12
03 35 00.00 10	CONCRETE FINISHING	3/9/12
03 39 00.00 10	CONCRETE CURING	3/9/12
DIVISION 04 – MASONRY		
04 20 00	MASONRY	3/9/12
DIVISION 05 – METALS		
05 05 23	WELDING, STRUCTURAL	3/9/12
05 40 00	COLD-FORMED METAL FRAMING	3/9/12
05 50 13	MISCELLANEOUS METAL FABRICATIONS	3/9/12
05 51 00	METAL STAIRS	3/9/12
05 51 33	METAL LADDERS	3/9/12
05 52 00	METAL RAILINGS	3/9/12
DIVISION 07 – THERMAL AND MOISTURE PROTECTION		
07 11 14	BITUMINOUS FLUID-APPLIED VAPOR BARRIER	3/9/12
07 21 13	BOARD AND BLOCK INSULATION	3/9/12
07 22 00	ROOF AND DECK INSULATION	3/9/12

DESIGN COMPLETE
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS CONT.

		DATE
07 51 13	BUILT-UP ASPHALT ROOFING	3/9/12
07 55 00	PROTECTED MEMBRANE ROOFING (PMR)	3/9/12
07 60 00	FLASHING AND SHEET METAL	3/9/12
07 84 00	FIRESTOPPING	3/9/12
07 92 00	JOINT SEALANTS	3/9/12
DIVISION 08 – OPENINGS		
08 11 13	STEEL DOORS AND FRAMES	3/9/12
08 34 01	FORCED ENTRY RESISTANT COMPONENTS	3/9/12
08 34 73	SOUND CONTROL DOOR ASSEMBLIES	3/9/12
08 71 00	DOOR HARDWARE	3/9/12
DIVISION 09 – FINISHES		
09 22 00	SUPPORTS FOR PLASTER AND GYPSUM BOARD	3/9/12
09 22 36	LATH	3/9/12
09 23 00	GYPSUM PLASTERING	3/9/12
09 24 23	STUCCO	3/9/12
09 29 00	GYPSUM BOARD	3/9/12
09 30 00	CERAMIC TILE, QUARRY TILE AND PAVER TILE	3/9/12
09 51 00	ACOUSTICAL CEILINGS	3/9/12
09 65 00	RESILIENT FLOORING	3/9/12
09 68 00	CARPET	3/9/12
09 69 13	RIGID GRID ACCESS FLOORING	3/9/12
09 83 13	ACOUSTICAL WALL TREATMENT	3/9/12
09 90 00	PAINTS AND COATINGS	3/9/12
09 96 00	HIGH PERFORMANCE COATINGS	3/9/12

DESIGN COMPLETE
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS CONT.

		DATE
VOLUME 2 OF 3		
DIVISION 10 – SPECIALTIES		
10 14 01	EXTERIOR SIGNAGE	3/9/12
10 14 02	INTERIOR SIGNAGE	3/9/12
10 21 13	TOILET COMPARTMENTS	3/9/12
10 28 13	TOILET ACCESSORIES	3/9/12
10 44 16	FIRE EXTINGUISHERS	3/9/12
DIVISION 12 – FURNISHINGS		
12 32 00	MANUFACTURED WOOD CASEWORK	3/9/12
DIVISION 13 – SPECIAL CONSTRUCTION		
13 48 00	SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT	3/9/12
13 48 00.00 10	SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT	3/9/12
DIVISION 21 – FIRE SUPPRESSION		
21 13 13.00 10	WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION	3/9/12
21 22 00.00 40	FM 200 FIRE EXTINGUISHING SYSTEMS	3/9/12
21 30 00	FIRE PUMPS	3/9/12
DIVISION 22 – PLUMBING		
22 00 00	PLUMBING, GENERAL PURPOSE	3/9/12
22 07 19.00 40	PLUMBING PIPING INSULATION	3/9/12
DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING		
23 00 00	AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS	3/9/12
23 01 30.41	HVAC SYSTEM CLEANING	3/9/12
23 03 00.00 20	BASIC MECHANICAL MATERIALS AND METHODS	3/9/12
23 05 15	COMMON PIPING FOR HVAC	3/9/12
23 05 93	TESTING, ADJUSTING AND BALANCING FOR HVAC	3/9/12

DESIGN COMPLETE
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS CONT.

		DATE
23 07 00	THERMAL INSULATION FOR MECHANICAL SYSTEMS	3/9/12
23 08 00.00 10	COMMISSIONING OF HVAC SYSTEMS	3/9/12
23 09 53.00 20	SPACE TEMPERATURE CONTROL SYSTEMS	3/9/12
23 23 00	REFRIGERANT PIPING	3/9/12
23 82 02.00 10	UNITARY HEATING AND COOLING EQUIPMENT	3/9/12

VOLUME 3 OF 3

DIVISION 26 – ELECTRICAL

26 00 00.00 20	BASIC ELECTRICAL MATERIALS AND METHODS	3/9/12
26 05 00.00 40	COMMON WORK RESULTS FOR ELECTRICAL	3/9/12
26 05 13.00 40	MEDIUM-VOLTAGE CABLES	3/9/12
26 05 19.00 10	INSULATED WIRE AND CABLE	3/9/12
26 05 48.00 10	SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT	3/9/12
26 08 00	APPARATUS INSPECTION AND TESTING	3/9/12
26 09 23.00 40	LIGHTING CONTROL DEVICES	3/9/12
26 12 19.10	THREE-PHASE PAD-MOUNTED TRANSFORMERS	3/9/12
26 23 00	SWITCHBOARDS AND SWITCHGEAR	3/9/12
26 24 16.00 40	PANELBOARDS	3/9/12
26 28 01.00 10	COORDINATED POWER SYSTEM PROTECTION	3/9/12
26 29 23	VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS	3/9/12
26 32 15.00 10	DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES	3/9/12
26 36 00.00 10	AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH	3/9/12
26 41 01.00 10	LIGHTNING PROTECTION SYSTEM	3/9/12
26 51 00	INTERIOR LIGHTING	3/9/12

DIVISION 27 – COMMUNICATIONS

27 05 28.36 40	CABLE TRAYS FOR COMMUNICATIONS SYSTEMS	3/9/12

DESIGN COMPLETE
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS CONT.

		DATE
27 10 00	BUILDING TELECOMMUNICATIONS CABLING SYSTEM	3/9/12
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY		
28 31 76	INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM	3/9/12
DIVISION 31 – EARTHWORK		
31 00 00	EARTHWORK	3/9/12
DIVISION 32 – EXTERIOR IMPROVEMENTS		
32 11 23	AGGREGATE BASE COURSE	3/9/12
32 13 13.06	PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES	3/9/12
32 13 73	COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS	3/9/12
32 15 00	AGGREGATE SURFACE COURSE	3/9/12
32 16 13	CONCRETE SIDEWALKS AND CURBS AND GUTTERS	3/9/12
32 31 13.53	HIGH-SECURITY CHAIN LINK FENCES AND GATES	3/9/12
DIVISION 33 – UTILITIES		
33 11 00	WATER DISTRIBUTION	3/9/12
33 16 15	WATER STORAGE STEEL TANKS	3/9/12
33 30 00	SANITARY SEWERS	3/9/12
33 56 10	FACTORY-FABRICATED FUEL STORAGE TANKS	3/9/12
33 70 02.00 10	ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND	3/9/12
33 82 00	TELECOMMUNICATIONS OUTSIDE PLANT (OSP)	3/9/12

SECTION 01 80 00.12 10

TECHNICAL REQUIREMENTS

PART 1 GENERAL

These technical requirements are for the design and construction of one Special Operations Forces Joint Operations Center and one Command and Control Facility on separate sites with the supporting infrastructure as per the site plan and design analysis.

1.1 CONTRACTOR'S DESIGN AND CONSTRUCTION

The Contractor's design and construction must comply with technical requirements contained herein. The Contractor shall provide design and construction using the best blend of cost, construction efficiency, system durability, ease of maintenance and environmental compatibility.

1.1.1 Design and Product Requirements

These design and product requirements are minimum requisites. Variations shall be submitted in accordance with Section 01 33 00 12 10 SUBMITTAL PROCEDURES FOR DESIGN-BUILD PROJECT. All variations must be approved by the Contracting Officer. Unless otherwise specified, all of the materials and equipment to be installed in this project shall comply with a recognized standard for the intended use. The Unified Master Reference List for ASTM, ASME, etc., located at www.ccb.org/docs/ufgshome/ufgstoc.htm identifies the titles and approval dates.

1.1.2 Asbestos Containing Materials

Asbestos containing material (ACM) will not be used in the design and construction of this project. If no other material is available which will perform the required function or where the use of other material would be cost prohibitive, a waiver for the use of asbestos containing materials must be obtained from the Contracting Officer.

1.1.3 Limitation of Working Space

The Contractor shall, except where required for service connections or other special reasons confine his operations strictly within the boundaries of the site. Workmen will not be permitted to trespass on adjoining property. Any operations or use of space outside the boundaries of the site shall be by arrangement with all interested parties. It must be emphasized that the Contractor must take all practical steps to prevent his workmen from entering adjoining property and in the event of trespass occurring the Contractor will be held entirely responsible.

1.1.4 Subcontractors

Compliance with the provisions of this section by subcontractors will be the responsibility of the Contractor.

1.1.5 Temporary Structures

The Contractor shall erect suitable temporary fences, lighting, and necessary structures to safeguard the site, materials and plant against

damage or theft and for the protection of the general public and shall adequately maintain the same throughout the course of the contract. All utilities required to support temporary structures during the contract period of performance shall be provided by the Contractor.

1.1.6 Site Conditions

a. Site Location: Kandahar Airfield, Kandahar, Afghanistan.

b. Site Elevation: 1010 Meters, Above Sea Level.

c. Ambient Temperatures: Summer 43.3 degrees C; winter -5.0 degrees C.

d. Maximum 43.3 degrees C dry bulb, 23.9 degrees C wet bulb.

e. Atmospheric Conditions: Dry and Dust-laden.

1.2 SPECIFICATIONS

All specifications except for those included in this RFP shall be developed by the Contractor in accordance with this specification and Section 01 33 00 12 10 SUBMITTAL PROCEDURES FOR DESIGN-BUILD PROJECT. The specifications included in this RFP shall be used verbatim and not edited by the Design-Build Contractor.

1.3 SECURITY AND OPERATIONAL SAFETY

1.3.1 General

The Contractor shall prepare a security/safety program that includes the preparation and monitoring of site security and operational safety.

1.3.2 Security

The Contractor shall prepare a plan for site security during construction. The plan shall be submitted with the first design submittal. The plan shall include detailed procedures for controlling access to the project site through the use of gate guards, ID badge, entry access lists and/or other measures as required by the Air Base. The Contractor shall become acquainted with all the required security measures of the Air Base during the proposal phase.

1.3.3 Operational Safety

1.3.3.1 Design Phase Safety

The Contractor shall submit airfield access requirements of design personnel at the Pre-Design Conference. The safety requirements and procedures for design personnel access to the project site will be established at the Pre-Design Conference. It is the Contractor's responsibility to ensure that design personnel are familiar with and follow airfield safety procedures.

1.3.3.2 Operational Safety Plan

The Contractor shall prepare an operational safety plan that addresses the requirements and safety considerations of paragraphs B14-5 and B14-6 in Section 14 of UFC 3-260-01. The plan shall address operational safety

during each project phase and subphase identified in the Phasing Plan. The operational safety plan shall be submitted with the first design submittal.

PART 2 CIVIL SITE DEVELOPMENT

2.1 GENERAL

The contractor shall perform design and construction services as required to provide a complete and usable site at the location shown on the drawings. The site requires some demolition, access roads, connection of utilities, and a fire suppression system with water capacities as indicated in the following sections.

The civil site development includes the following items of work:

a. Topographic Survey
b. Environmental Protection
c. Demolition
d. Utility Infrastructure - Design & Construct
e. Grading and Drainage - Design & Construct
f. Pavements and Siting - Design & Construct

2.2 Drawings

The RFP drawings include a general site plan, pavement design and required utility details. The site plan provided in the RFP indicates approximate existing conditions and shall be verified by the contractor with a complete topographic survey of the site prior to starting design.
Existing and proposed utility locations are subject to verification by the Contractor and approval of the Contracting Officer.

2.3 Design Criteria

USACE Middle East District Design Instructions Manual

24-hour Precipitation, Extreme Value Analysis for Kandahar Air Base Afghanistan by Air Force Combat Climatology Center.
https://www2.afccc.af.mil/forms_mil/html/sarform.html

Pavement-Transportation Computer Assisted Structural

Engineering (PCASE) Program. http://www.pcase.com

UNIFIED FACILITIES CRITERIA (UFC)

Uniform Facility Criteria (UFC) documents are available on the Internet at http://www.hnd.usace.army.mil/techinfo/engpubs.htm

UFC 3-210-01A Area Planning, Site Planning, and Design

UFC 3-210-02 POV Site Circulation and Parking, Jan 04

UFC 3-210-06A Site Planning and Design, Jan 06

UFC 3-230-01 Surface Drainage Design, Aug 06

UFC 3-230-03A Water Supply

UFC 3-230-04A Water Distribution

UFC 3-230-06A Subsurface Drainage Design, Jan 04

UFC 3-230-09A Water Supply: Water Storage

UFC 3-230-010A Water Supply: Water Distribution

UFC 3-230-13A Water Supply: Pumping Stations

UFC 3-230-17FA Drainage in areas other than Airfields

UFC 3-240-07FA Sanitary and Industrial Wastewater Collection: Gravity Sewer and Appurtenances

UFC 3-250-01FA Pavement Design for Roads, Streets, Walks and Open Storage Areas, Jan 04

UFC 3-250-09FA Aggregate Surfaced Roads and Airfield Areas

UFC 3-250-11 Soil Stabilization for Pavements, Jan 04

UFC 3-250-18FA General Provisions and Geometric Design for Roads, Streets,Walks, and Open Storage Areas, Jan 04

UFC 3-600-01 Fire Protection Engineering for Facilities, Sept 06

UFC 4-010-01 DOD Minimum Antiterrorism Standards for Buildings

ARMY FIELD MANUAL (FM)

FM 5-430-00-2 Planning and Design of Roads, Airfields and Heliports in the Theater of Operations - Airfield and Heliport Design, Jan 06

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318 Building Code Requirements for Structural Concrete, 2005

ACI 305R Hot Weather Concrete, 1999

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 Minimum Design Loads for Buildings and Other Structures, 2005

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, 2008

ASTM A 185 Steel Welded Wire Fabric, Plain for Concrete Reinforcement, 2007

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 Steel Construction Manual, 13th Edition

INTERNATIONAL CODE COUNCIL INCORPORATED

IBC International Building Code, 2006

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 415 Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways, 2008

USCENTCOM FORCE PROTECTION STANDARDS

OPORD 05-01 Force Protection Construction Standards (Appendix V)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

MUTCD Manual on Uniform Traffic Control Devices, 2001

GREEN BOOK A Policy on Geometric Design of Highways and Streets, 2001

AASHTO HS20-44 LRFD, Specifications for Highway Bridges, 2008

2.4 Site Survey

Following the criteria in specification 02 21 00 TOPOGRAPHIC SURVEY and submitted in accordance with Section 01 33 00 12.10 SUBMITTAL PROCEDURES FOR DESIGN-BUILD, a topographic survey shall be produced of the project site and establish all necessary permanent benchmarks for vertical and horizontal control. Upon completion of the construction, the original survey shall be updated with an as-built survey of the site as constructed. The as-built survey shall be submitted to the COR for approval. The original and as-built survey shall include location and elevation of all relevant existing site features within the project limits. This includes the elevation and location of buildings (new and existing), roadways, pads, other structures, drainage systems, and utilities (subsurface and overhead) within 10 meters of the project sites.

2.5 Environmental Protection

2.5.1 Applicable Regulations

The Contractor shall comply with all laws, rules, regulations or standards concerning environmental pollution control and abatement at Kandahar Airfield.

2.5.2 Notification

The Contracting Officer will notify the Contractor in writing of any observed non-compliance with the paragraph entitled ENVIRONMENTAL PROTECTION. The Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No extension of time or damages will be awarded to the Contractor unless it was later determined that the Contractor was in compliance.

2.5.3 Spillages

Measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides and insecticides, and construction materials from polluting the construction site and surrounding area. Any type of spill shall be reported to the Fire Department.

2.5.4 Disposal

Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., shall be subject to the approval of the Contracting Officer. Burning at the project site for the disposal of refuse and debris will not be permitted.

2.6 Hazardous Materials and Contamination

The Government does not anticipate that the Contractor will be required to remove or dispose of any hazardous materials or waste during the site preparation phase of this project.

2.7 Demolition and Removal

The Contractor shall stake-out the project boundaries before starting work. Existing utilities that interfere with this project will be relocated. Any demolition debris shall be removed from the site. The COR will designate a site off base. Rubbish and debris shall be removed daily, unless otherwise directed, to avoid accumulation at the demolition site, do not allow accumulations inside or outside the buildings.

In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible. Use of explosives will not be permitted.

Saw cut and remove concrete and asphaltic concrete paving and slabs including aggregate base as necessary. Provide neat saw cuts at limits of pavement removal as necessary. Pavements shall be removed in a manner such to ensure no damage to adjacent existing pavements that will remain in place. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas.

2.8 Excavation

Any hand digging, driving of pickets or excavation of any kind requires a Dig Permit. If work requires digging, the Contractor must obtain a digging permit from the Contracting Officer.

When digging must be done, backfill the resulting hole/trench with clean fill or material as described in the Government provided specification or Contractor provided specification as applicable, at the earliest opportunity. If digging is to be done manually, then the Contractor must submit Site Specific Safety and Health Plan (SSHP) which meets EM 385-1-1, Section 28.

2.9 New Site Design and Construction

The concept site plan drawings present a suggested geometric layout for the site work. The Contractor shall design each of the site features shown on the Site Plan and otherwise specified in the RFP. This site plan includes the approximate location of the building, associated access, generator, fuel storage tank, water storage tanks. This schematic design must be verified by the contractor.

The Contractor shall ensure the facilities are sited in compliance with the attached drawings and additional requirements stated herein.

The site plan prepared by the Contractor shall show geometric design of the site, including applicable dimensions of facilities, pavements, set back lines, fences, etc.

2.10 Utilities

The Contractor shall design, construct, test, and disinfect the fire water storage tanks and distributions systems. The Contractor shall design, construct, and test the sewage collections system.

There may be existing electric, communications and other utility lines on and under the project sites. It is the Contractor's responsibility to confirm the specific locations of the existing utilities and to design, adjust or protect utility services in the project sites. Coordination of all site work on the project, including utility work, is the responsibility of the Contractor. Follow requirements of part 2.7 "Demolition and Removal", this section when adjusting utilities.

2.10.1 Water Distribution

Contractor shall design, furnish, install, disinfect and test the domestic and fire water service. See specifications 33 11 00 Water Distribution and 33 16 15 Water Storage Steel Tanks.

2.11 Sanitary Sewer System

Contractor shall design, furnish, install, and test sewage collection system.

See specification 33 30 00 Sanitary Sewers.

2.12 Earthwork, Site Grading and Off-site Drainage

2.12.1 Earthwork

Perform all earthwork necessary to provide the building, access and supporting infrastructure as shown on the plan.

2.12.2 Site Grading

Finished grade shall slope away from the project sites and provide positive drainage. Swales and cross-culverts shall be provided as required and have a minimum longitudinal gradient of 0.5%. Any side slopes will be no steeper than 1 vertical on 4 horizontal.

Plans shall show existing contours and new contours to indicate new grading, finished floor and pavement elevations, drainage swales, etc.

2.12.3 Storm Drainage

2.12.3.1 Storm Drainage

The Contractor will provide all necessary site grading and provided with necessary drainage structures to ensure adequate drainage, so that no water

shall pond within 23 meter of any paved area or building resulting from a 10-year recurrence storm.

All storm drainage system designs shall be in accordance with references contained herein. Storm drainage system design shall consist of swales, side slopes, and culvert piping where necessary to provide adequate drainage for the project sites. All storm drainage piping located in traffic areas shall be rated to withstand wheel loading from the design vehicle.

Design flows shall produce velocities suitable to flush collected dust and debris accumulation during storm events. Unless otherwise directed by the Contracting Officer, the Contractor shall use reinforced concrete pipe exclusively. Design storm values are tabulated in Appendix B to these Technical Requirements.

The topographic survey shall be used in designing the grading and drainage. The Contractor will provide all necessary site grading to ensure adequate drainage so that no utilities or manholes, facilities or pavements will be flooded due to a design rainfall. Drainage of the area should be compatible with the existing terrain

PART 3 SUBMITTALS

3.1 Civil

Contractor shall submit documents for each phase of submittals with the level of information as indicated in the USACE Middle East District Design Instructions Manual.

3.1.1 Mapping

The surveyor shall provide a tabulated list (bound booklet) with adjusted coordinates and elevations of all permanent survey monuments established on the project in accordance with Specification 02 21 00. The surveyor shall complete and submit with field books, the field adjustments computation sheets in accordance with Specification 02 21 00. The surveyor shall complete and submit the final survey and mapping in accordance with Specification 02 21 00.

3.1.2 Design Analysis

The Design Analysis shall include, but not be limited to the following specific items:

a. Grading and Drainage. The design analysis shall include the run off calculations and criteria used in creating the site grading and profiles of the culverts.

b. The contractor shall provide manufacturer's catalog data and shop drawings for material and equipment to be installed on the project. The shop drawings shall include detail drawings to include fabrication and erection details, and structural connections.

c. Utility System. The design analysis shall include detailed description of existing and proposed systems within the limits of the construction site. Discussions and calculations supporting the sizing and selection of any proposed utility system including, but

not limited to pipes, tanks, pumps, and hydro-pneumatic tanks.

d. Asphalt pavement design and material selection criteria.

e. Concrete design and material selection criteria.

3.1.3 Specifications

Specifications shall indicate applicable design standards and criteria followed, standards that the selected equipment and material shall comply with, method of equipment installation, and other construction requirements that the designer may see fit. The Contractor shall use the specifications and definitions provided in the Unified Facilities Guide Specifications (UFGS) to create the demolition, environmental, and any other site related specification required. The Unified Facilities Guide Specifications (UFGS) and SPECSINTACT software are available free of charge for downloading from http://www.ccb.org/ufgs/ufgs.htm. Where UFGS do not include a specification for a particular feature of work, a Federal Aviation FAA specification is available for a particular feature of work; the Contractor may use specifications from other agencies or sources, or provide custom-written specifications. Such specifications only may use another software program than SPECSINTACT. The specifications for this project shall be edited and submitted in hand marked-up or graphic highlighted (via word processor or specification software) draft version at the Preliminary Review submittal stage.

UFGS shall be edited only as directed in the specification notes and instructions, where choice options allow, and where features of work are added or deleted. A minimum quality standard for the project shall be maintained by only selecting among the choices for quantity and quality that are presented in the applicable UFGS, unless specifically indicated otherwise in this section.

Manufacturer's catalog cut sheets will not be accepted as a substitute for the "products" portion of the specifications, nor any other part. Catalog cut sheets may be added to the specifications, but not as a substitute.

3.1.4 Construction Phasing Plan and Environmental Plan

Contractor shall provide the environmental plan prior to start of construction.

3.1.5 Drawings

The following specific items shall be shown on the drawings when applicable, for each submittal.

3.1.6 Civil Site Development, Contractor Furnished Drawings

The plans shall include, but not be limited to the following:

a. Location plan showing the location of the existing structures and proposed site improvements on an overall plan of the entire base.

b. Site plan showing the horizontal location of the proposed structures, fences, walls, and all other site improvements in relation to each other and existing site features. The site plan shall show detailed geometric design of the site and utilities,

including applicable dimensions of facilities, setbacks, etc. The Contractor provided topographic survey shall serve as the base map for the site plan.

c. Grading plan showing the existing and proposed site grading and any surface or subsurface drainage facilities. A contour interval of 0.25 meters shall be used. Final contours shall be furnished to show the full scope of the project. Spot elevation at all pertinent locations including but not limited to grade breaks, stabilized surfaces, corners of asphalt pavement and concrete pavement joints, fence corners, building corners, controlling elevations of ditches or drainage courses, and entry control points will be included on the grading plan. Ground floor elevation for each structure will be included on the grading plan. The Contractor provided topographic survey shall serve as the base map for the grading plan.

d. Utility plan showing existing and proposed domestic water distribution system, sanitary sewer system, and storm sewer system including pipe size, pipe slope, gravity flow pipe inverts, trench details, etc. Details of utility system shall be provided.

e. Construction details providing sufficient detail to accurately construct the required site features.

f. Demolition plans shall clearly delineate all existing features to be removed.

PART 4 ATTACHMENTS

The following attachments form an integral part of this specification:

Appendix A - 24-Hour Precipitation Analysis

-- End of Section --

24-Hour Precipitation
EXTREME VALUE ANALYSIS

Kandahar Afghanistan

31.5 N 65.85 E
ELEVATION = 1010 METERS

PERIOD OF RECORD: 1958 - 1973, 1975 - 1977, 2002 - 2007

QUANTILES	0.1	0.2	0.5	0.8	0.9	0.95	0.98	0.99	0.999	0.9999
RETURN PERIOD (YRS)	1.1	1.25	2	5	10	20	50	100	1000	10000
VARIATE 24 Hour Precipitation (inches)	0.46	0.65	1.1	1.64	1.97	2.26	2.61	2.86	3.63	4.33

NOTE: The return period is the average elapsed time between occurrences of an event with a certain magnitude or greater.

DESIGN CALCULATED RISK

VARIATE 24 Hour Precipitation (inches)	DESIGN LIFE (YEARS)									
	5	10	15	20	25	30	35	40	45	50
0.46	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0.65	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.10	0.969	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.64	0.672	0.893	0.965	0.988	0.996	0.999	1.000	1.000	1.000	1.000
1.97	0.410	0.651	0.794	0.878	0.928	0.958	0.975	0.985	0.991	0.995
2.26	0.226	0.401	0.537	0.642	0.723	0.785	0.834	0.871	0.901	0.923
2.61	0.096	0.183	0.261	0.332	0.397	0.455	0.507	0.554	0.597	0.636
2.86	0.049	0.096	0.140	0.182	0.222	0.260	0.297	0.331	0.364	0.395
3.63	0.005	0.010	0.015	0.020	0.025	0.030	0.034	0.039	0.044	0.049
4.33	0.000	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.004	0.005

NOTE: Design Calculated Risk is the probability that the weather threshold (variate) will be exceeded at least once within a particular number of years (design life).

SECTION 02 21 00

TOPOGRAPHIC SURVEY

PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-1-1002	(1990) Engineering and Design - Survey Markers and Monumentation
EM 1110-1-1003	(2003) Engineering and Design - NAVSTAR Global Positioning System Surveying
EM 1110-1-1005	(2007) Engineering and Design - Control and Topographic Surveying

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Final Survey and Mapping; G

Field Books

Coordination and Elevation Booklet

Final Adjusted Survey; G

1.3 Project Description

The services described hereinafter pertain to surveying and mapping services for the Command and Control Facility at Kandahar, Afghanistan.

1.3.1 Final Survey and Mapping

One (1) set of minimum 600 by 900mm size hard copy. All drawings shall be computer generated and provided on a CD ROM. Each sheet shall include a north arrow, legend, survey data, datum data and sheet index plan showing its relationship with the entire project area. In addition, one drawing, at a conventional scale shall show the entire survey area. The computer files shall be georeferenced.

1.3.2 Final Adjusted Survey

Diskettes or CD ROM containing digital file(s) of the final adjusted survey, in the format specified in Paragraph 3.4 of this section. One of the files shall contain the entire survey area, the other files shall contain the individual sectors used to create the hard copy sheets.

1.3.3 Field Books

All field books and computation sheets with sketches.

1.3.4 Coordination and Elevation Booklet

One bound booklet with adjusted coordinates and elevations. Also detailed descriptions of each concrete survey monument established on site.

PART 2 PRODUCTS

2.1 Concrete Monuments

Concrete monuments shall be manufactured and in conformance with the requirements of USACE document EM 1110-1-1002.

PART 3 EXECUTION

3.1 General

The following paragraphs describe the Scope of Work for performing the surveys and the digitization of the topographic data.

Prior to commencing any survey activities the Contractor shall meet with the Contracting Officer to establish the limits of survey required. The survey shall not be limited to the site perimeter. The survey limits shall extend beyond the site perimeter to a field determined location sufficient to ensure adequate and pertinent information is obtained to address the wastewater effluent disposal location and the Contractor designed grading and drainage requirements established in Section 31 00 00 EARTHWORK. Refer to paragraph 3.2.1.4 for additional information.

3.2 Survey Requirements

3.2.1 Horizontal and Vertical Control

3.2.1.1 Coordinate Systems

The survey shall be based on the local Universal Transverse Mercator Grid Zone, World Geodetic System (WGS84) and the elevation should be height above ellipsoid (WGS84) and sea level (EGM96). If there has been gravitational surveys performed nearby, these shall be noted. A survey database file for all features should show both ellipsoid height and Geoid height and WGS84 latitude/longitude as well as UTM coordinates. WGS84 data shall be corrected to WGS84 (G1150) datum reference. GPS benchmarks shall be documented at ITRF2000 coordinates referenced to epoch 1997. Basic project control surveys will be performed using precise differential carrier-phase tracking Navstar GPS measurement procedures or electronic data collection total stations.

3.2.1.2 Accuracy Requirements

Differential GPS baseline vector observations will be made in strict accordance with the criteria contained in EM 1110-1-1003, except as modified or amplified herein. Conventional survey observations shall be made in accordance with criteria contained in EM 1110-1-1005 for General Site Development, except as modified or amplified herein.

3.2.1.3 Control Systems

Install a minimum of three survey monuments on each survey site following the requirements contained in EM 1110-1-1002. A minimum of two benchmarks must be visible by line of site at each station. Monuments placed on project site shall be designed to survive proposed construction operations by use of proper location and construction techniques. The horizontal and vertical control shall be tied to the existing site control.

a. All of the control points established at the site shall be plotted at the correct coordinate point and shall be identified by name or number, and adjusted elevations.

b. All Topographic survey point sets produced with conventional survey instruments shall be referenced directly to horizontal and vertical control points by level loop and closed traverse.

3.2.1.4 Survey Sites

The location of the survey sites shall be shown to the contractor by the Contracting Officer's representative (COR). The limits of the survey and proposed location of the survey monuments shall then be identified by temporary markers and a sketch, with coordinates, of the area to be surveyed shall be submitted for approval by the COR before proceeding with the survey.

3.3 Topography Requirements

A sufficient quantity of horizontal and vertical control data shall be established to provide a detailed topographic survey with twenty five (25) centimeter contour intervals. Intermediate elevations shall be provided as necessary to show breaks in grade and changes in terrain.

3.3.1 Contours

The contours shall accurately express the relief detail and topographic shapes. In addition, 90 percent of the elevations or profiles interpolated from the contours shall be correct to within one-half of the specified contour interval and spot elevations shall be correct within plus or minus 3 centimeters.

3.3.2 Projection Grid

The projection grid (which shall be a metric rectangular coordinate system with a grid spacing of 50 meter intervals) and the control points shall be plotted correctly to the nearest 0.3 millimeter. The horizontal position of 90 percent of definitely recognizable points shall be plotted correctly with reference to the nearest control point within 0.6 millimeter.

3.3.3 Elevations

Where applicable, spot elevations and or finish floor elevations of structures or facilities shall be provided. Specifically, show all break points or control points in grades of terrain such as tops of hills, top and bottom of curbs, bottoms of ditches and gullies, high bank elevations, etc. Ground elevations shall be read to the closest 3 centimeters. Road elevations shall be read to the closest 3 millimeters.

3.3.4 Features

All surface and known sub-surface features, buildings, structures, etc. within the area to be surveyed shall be shown, spot elevations provided and identified on the topographic maps. In addition, these features shall be located by sufficient distance ties and labeled on the topographic sheets to permit accurate scaling and identification.

3.3.5 Survey Boundaries

Manholes and sanitary lines within the survey boundaries shall be located and invert elevations obtained. Water, sanitary, fuel, electrical and mechanical utilities within the survey site shall be located and shown on the survey map. Invert elevations will be on the bottom lip of each pipe in the manhole to include the depth of the manhole must be taken also. Water, sanitary, fuel, electrical and mechanical utilities within the survey site shall be located and shown on the survey map and provided digitally in the database.

3.4 Digital Format/Survey Mapping

3.4.1 General Design File Requirements

The topographic data for the entire project, shall be compliant according to the A/E/C CADD Standard Manual Version 3.0, which is available at https://cadbim.usace.army.mil/. The data shall be placed into a single Microstation In-Roads V8 or AutoCAD Map 3D Version 2004 file. If the design file exceeds 10 MB, a separate design file consisting of topographic data only shall be prepared and shall be referenced to the primary file.

3.4.2 3D Design Files

Only the topographic feature data (spot elevations and contours) are required to be placed into 3D design file(s) at their proper elevation. Surface and subsurface features shall be placed in the 3-D file(s) at elevation zero (0).

3.4.3 Digital Terrain Model

A Digital Terrain Model shall be furnished compatible with Microstation In-Roads V8. A sufficient number of field acquired data points and breaklines are required to generate the contours of the mapping area. Breaklines are to be used to represent abrupt grade breaks such as road centerline, top and bottom of curb, top and bottom of ditch, etc.

3.4.4 Design File Units

Master Units: Meters (M)
Subunits: 1000 MM
Positional Units: 10

3.4.5 Angle Format

The angle format shall be degrees, minutes, and seconds to one decimal place.

3.4.6 Locks

All locks, except snap, will be off. All displays will be on except text nodes and curve fast display.

3.4.7 Topographic Data

All topographic data shall be shown in "Model" space, Any individual sheets shall be shown in "Paper" space.

3.4.8 Grid Lines

Grid lines shall be placed in the design file at 100 m intervals. Coordinates shall be placed on the grid lines for the datum specified.

3.4.9 Format

The level names, line styles, line weights, and line colors shown in Table 1 shall be used. Text shall be in capital letters and appear to be 3 mm when plotted. Include any standards sheets (abbreviations, symbols libraries, font libraries, color tables, pen tables, plot configuration files, user command files, etc.) necessary for a complete project.

3.4.10 3-D File

Each 3-D file shall be checked by viewing a front or side view to detect errors in element elevation.

3.4.11 Drawing Creation

Contractor will not scale drawings to conform to meters. All drawings must be CREATED using meters.

Table 1
Survey/Mapping Level Assignments
and Level Symbology

Layer Name	Description	Line Styles	Line Weight	Line Color
V-ANNO-DIMS	WITNESS/EXTENSION LINES, DIMENSION TERMINATORS, DIMENSION TEXT	Continuous	0	1
V-ANNO-KEYN	REFERENCE KEYNOTES WITH ASSOCIATED LEADERS	Continuous	0	2
V-ANNO-NPLT	NON-PLOTTING GRAPHIC INFO	Continuous	0	5
V-ANNO-PATT	MISCELLANEOUS PATTERNING AND HATCHING	Continuous	0	8
V-ANNO-NOTE	GENERAL NOTES AND GENERAL REMARKS	Continuous	0	2
V-ANNO-SYMB	MISCELLANEOUS SYMBOLS	Continuous	0	6
V-ANNO-TEXT	MISCELLANEOUS TEXT AND CALLOUTS WITH ASSOCIATED LEADERS	Continuous	0	2
V-ANNO-REFR	REFERENCE FILES	NA	NA	NA
SURVEY LINES				
V-SURV-DATA	SURVEY DATA (BENCHMARKS AND HORIZONTAL CONTROL POINTS OR MONUMENTS)	Continuous	0	6
V-SURV-LINE	SURVEY, BASELINE, AND CONTROL LINE	Long Dash	0	4
V-SURV-IDEN	SURVEY, BASELINE, AND CONTROL LINE ANNOTATOR	Continous	0	6
BUILDINGS AND STRUCTURES				
V-BLDG-OTLN	BUILDINGS AND OTHER STRUCTURES	Continous	0	7
V-BLDG-IDEN	BUILDINGS AND OTHER STRUCTURES ANNOTATOR	Continuous	0	2
SITE				
V-SITE-FENC	FENCES AND HANDRAILS	Continuous	0	6

Table 1
Survey/Mapping Level Assignments
and Level Symbology

Layer Name	Description	Line Styles	Line Weight	Line Color
V-ANNO-DIMS	WITNESS/EXTENSION LINES, DIMENSION TERMINATORS, DIMENSION TEXT	Continuous	0	1
V-SITE-FENCE-IDEN	FENCE, HANDRAIL, RAMP, AND TRAIL ANNOTATION	Continuous	0	6
V-SITE-STRC	STRUCTURES (BRIDGES, SHEDS, FOUNDATION PADS, FOOTINGS, ETC)	Continuous	0	22
V-SITE-IDEN	EXISTING SITE FEATURE/STRUCTURE ANNOTATION	Continuous	0	6
V-SITE-OTLN	EXISTING SITE FEATURES (PLAY STRUCTURES, BIKE RACKS, BENCHES, RECREATIONAL EQUIPMENT)	Continuous	0	4
V-SITE-EROS	RIPRAP, REVETMENTS/STONE PROTECTION, BREAKWATERS, DIKES, JETTIES, AND DRAINS	Continuous	0	1
V-SITE-EWAT	WATER FEATURES	Continuous	0	162
V-SITE-STRS	STAIRS AND RAMPS	Continuous	0	6
V-SITE-WALK	WALKS, TRAILS, AND BICYCLE PATHS	Continuous	0	2
V-SITE-VEGE	EXISTING TREELINES AND VEGETATOR	Continuous	0	82
UTILITIES				
V-UTIL-SSWR	SANITARY LINES AND MANHOLES	Continuous	0	4
V-UTIL-SSWR-IDEN	SANITARY ANNOTATION	Continuous	0	2
V-UTIL-SSWR-WATR	WATER LINES, HYDRANTS, TANKS	Continuous	0	4

Table 1
Survey/Mapping Level Assignments
and Level Symbology

Layer Name	Description	Line Styles	Line Weight	Line Color
V-ANNO-DIMS	WITNESS/EXTENSION LINES, DIMENSION TERMINATORS, DIMENSION TEXT	Continuous	0	1
V-UTIL-SSWR-WATR-IDEN	WATER ANNOTATION	Continuous	0	2
V-UTIL-UTIL-NGAS	GAS LINES, FEATURES, AND VALVES	Continuous	0	4
V-UTIL-NGAS-IDEN	GAS ANNOTATION	Continuous	0	2
V-UTIL-STEM	STEAM LINES AND ANNOTATION	Continuous	0	2
V-UTIL-STRM	STORM SEWER LINES, CULVERTS, MANHOLES, AND HEADWALLS	Continuous	0	4
V-UTIL-STRM-IDEN	STORM SEWER ANNOTATION	Continuous	0	2
V-UTIL-ELEC	POWER LINES, LIGHTS, TELEPHONE POLS, COMMUNICATION LINES	Continuous	0	4
V-UTIL-ELEC-IDEN	POWER/COMMUNICATION ANNOTATION	Continuous	0	2
PAVEMENTS/TRANSPORTATION				
V-PVMT-ROAD	ROADS, PARKING LOTS, RAILROADS, AIRFIELD PAVEMENTS	Continuous	0	2
V-PVMT-IDEN	ROAD, PARKING LOT, RAILROAD, AIRFIELD PAVEMENT ANNOTATION	Continuous	0	2
V-PVMT-PATT	JOINT PATTERNS, TEXT, AND DIMENSIONS	Continuous	0	2
V-PVMT-MRKG	PAVEMENT MARKINGS AND SIGNS	Continuous	0	2
TOPOGRAPHY				
V-TOPO-DTCH	DITCHES AND SWALES	Continuous	0	3

Table 1
Survey/Mapping Level Assignments
and Level Symbology

Layer Name	Description	Line Styles	Line Weight	Line Color
V-ANNO-DIMS	WITNESS/EXTENSION LINES, DIMENSION TERMINATORS, DIMENSION TEXT	Continuous	0	1
V-TOPO-BORE	BORING LOCATIONS	Continuous	0	6
V-TOPO-COOR	COORDINATE GRID TICKS AND TEXT	Continuous	0	122
V-TOPO-MAJR-IDEN	MAJOR CONTOURS ANNOTATION	Continuous	0	2
V-TOPO-MAJR	MAJOR CONTOURS	Continuous	0	2
V-TOPO-MINR-IDEN	MINOR CONTOURS ANNOTATION	Continuous	0	3
V-TOPO-MINR	MINOR CONTOURS	Continuous	0	3
V-TOPO-SPOT	SPOT ELEVATIONS	Continuous	0	2
V-TOPO-SLOP-TOPT	TOP/TOE SLOPES	Continuous	0	6
V-TOPO-BKLN	BREAKLINES	Centerline	0	7
V-TOPO-DTMT	DTM TRIANGLES	Continuous	0	22
V-TOPO-DTMP	DTM POINTS	Continuous	0	6

-- End of Section --

SECTION 02 33 00

SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION

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. Unless otherwise directed, use ASTM standards for the explorations/sampling and field and laboratory tests. Use foreign standards in cases where there are no ASTM standards assigned to a particular test. The following standards are provided for guidance and are not intended to be the only applicable standards. Note:

ASTM D 420 may be used as a guide for the selection of the various ASTM standards that are available for the investigation of soil, rock, and ground water.

ASTM INTERNATIONAL (ASTM)

ASTM C 1580	(2009) Standard Test Method for Water-Soluble Sulfate in Soil
ASTM D 1452	(1980; R 2000) Soil Investigation and Sampling by Auger Borings
ASTM D 1586	(2008a) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587	(2008) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 1883	(2007e2) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2113	(2008) Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(2009a) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 2974	(2007a) Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4220	(1995; R 2007) Preserving and Transporting Soil Samples

ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 5434	(2009) Field Logging of Subsurface Explorations of Soil and Rock
ASTM D 6032	(2008) Determining Rock Core Designate (RQD) of Rock Core
ASTM G 57	(2006) Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

British Standard (BSI)

BS 1377, Part 3	(1990) Methods of Test for Soils for Civil Engineering Purposes. Chemical and Electro-chemical Tests

1.2 WORK SUMMARY

Geotechnical services are required for the Command and Control Facility(C2) to be located in Kandahar, Afghanistan. This scope of work (SOW) defines work required of the Contractor to complete the geotechnical investigation and obtain approval by the Contracting Officer prior to the start of construction. Work will consist of the following:

a Perform Survey of geotechnical explorations and testing locations
b Perform and log field explorations and sampling.
c Perform and report field resistivity testing.
d Collect representative soil samples for laboratory testing.
e Perform and report laboratory testing.
f Provide foundation and pavement recommendations for facilities.
g Write a detailed Geotechnical Report for the project. The Geotechnical Report should include but not limited to the information described in Paragraph 2.3.

1.3 TERMINOLOGY

For purposes of this specification, the term "Contracting Officer" means the USACE Contracting Officer. The term "Geotechnical Engineer" means the employee or agent of the Contractor responsible for geotechnical services.

1.4 GEOTECHNICAL INVESTIGATION PLAN

The Contractor is responsible for the project's geotechnical investigation. The Contractor shall determine all necessary geotechnical conditions/parameters by appropriate field and laboratory tests and supporting calculations. The Contractor shall perform the Geotechnical Investigation in accordance with the information contained on Drawings and as stated herein.

1.5 PROFESSIONAL QUALIFICATIONS

All geotechnical engineering design parameters shall be developed by a Geotechnical Engineer or geotechnical firm responsible to the Contractor. The Geotechnical Engineer or geotechnical firm shall be qualified by meeting all of the following: education in geotechnical engineering (either

by specific training leading to an engineering degree or through a combination of courses in geology and engineering leading to an equivalent degree); professional registration; and a minimum of ten (10) years of experience in geotechnical engineering design having worked on projects of similar size, scope and cost. Foreign education and registration will be accepted if they provide equivalent level of knowledge and competency as that required by US standards.

1.6 SYSTEM DESCRIPTION

The Contractor shall provide the data to determine the type, nature, and characteristics of subsurface materials and the extent and conditions of the various materials as they exist to the depths and at the locations specified. This is to be accomplished by means of exploratory borings and test pits.

1.6.1 Survey Requirements

All boring, test pit and field testing locations shall be surveyed. Vertical and horizontal control shall be correct to the nearest 10 centimeters. Horizontal and vertical control shall comply with the Topographic Survey requirements specified in Section 02 21 00 TOPOGRAPHIC SURVEY.

1.6.2 Field Explorations

The following test methods are provided as minimums. The Contractor should consider additional test methods as may be necessary to obtain sufficient information to characterize the site.

1.6.2.1 Exploration Log Preparation

Prepare logs of all borings and test pits in accordance with ASTM D 653, and ASTM D 5434. All soils shall be field classified in accordance with ASTM D 2488. Finalized logs ready for publication shall be prepared from the field logs and adjusted to reflect the results of the laboratory testing.

1.6.2.2 Borings

Drilling operations shall consist of drilling, sampling, and logging the soil and rock strata. Borings shall be in accordance with ASTM D 1452, ASTM D 1586, ASTM D 6032, ASTM D 1587, ASTM D 2113, and ASTM D 2488. Standard Penetration Test (SPT) shall be taken in each boring at 1.5 meter intervals beginning at ground surface and continued when in soil to the bottom of boring or refusal. The depths of these explorations shall be in accordance with paragraph 1.10. Keep in mind that final grade and existing grade may not be the same. The Contractor is responsible for developing the site grading requirements. The proposed bearing depth below final grade will dictate the zone of influence for each foundation system. Locations may be moved to avoid obstructions or to ensure safety. All soil samples shall be collected in sufficient size, quantity and quality to perform the required laboratory tests identified herein. Backfill all borings before demobilizing.

1.6.2.3 Test Pits

Excavate test pits for the purpose of sampling, logging and obtaining materials for laboratory testing. Test pits shall be in accordance with

ASTM D 2488 and ASTM D 5434. All soil samples shall be collected in sufficient size, quantity and quality to perform the required laboratory test.

1.6.2.4 Test Pit Excavation and Sampling

Excavate test pits in soil, hardpan, decomposed rock, or other unconsolidated or partially consolidated overburden materials with an open cross-sectional area large enough to permit efficient excavation and shoring/lining, engineering and geological inspection and photographing of the subsurface soils and manual undisturbed sampling from within the test pit.

1.7 SUBMITTALS

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

SD-02 Shop Drawings

Driller's Logs; G

The Contractor shall submit complete, legible copies of DRILLING LOG, ENG FORM 1836 and 1836A and records to the Contracting Officer upon completion of the work or at such other time or times as he may be directed. Copies of logs and forms are available from the Contracting Officer.

SD-03 Product Data

Permits, Certifications, and Licenses

Copies of all permits, certifications, and licenses prior to starting work.

Schedule of Drilling, Sampling, Test Pits and Testing; G

Prior to starting work, the Contractor shall submit a plan for drilling, sampling, test pits, testing, and safety. The plan shall include, but shall not be limited to, the proposed method of drilling and sampling including a description of the equipment and sampling tools that will be used, a listing of any subcontractors to include a description of how the subcontractors will be used and a description of all methods and procedures that will be utilized to insure a safe operation and to protect the environment. No work shall be performed until this plan has been approved and no deviation from the approved plan will be permitted without prior approval by the Contracting Officer.

1.8 CARE AND DELIVERY OF SAMPLES

1.8.1 General

The Contractor shall be solely responsible for preserving all samples in good condition. Samples shall be kept from freezing and from undue exposure to the weather, and shall keep all descriptive labels and

designations on sample bags clean and legible. All samples shall be collected in sufficient size, quantity and quality to perform the laboratory tests.

1.8.1.1 Sampling of Soil

Collect, label, store and transport soil sample in accordance with ASTM D 1452, ASTM D 1586, ASTM D 1587, and ASTM D 4220. As a minimum, provide project title/location, exploration number, date of sample, driller's name and any other pertinent information deemed necessary to identify and track the samples' chain of custody and disturbance history.

1.9 PROJECT/SITE CONDITIONS

1.9.1 Field Measurements

The approximate locations of exploratory borings and test pits are shown on the drawings. The actual locations will be established in the field by the Contractor and reviewed by the Contracting Officer prior to the start of work. The elevations of the established locations will be provided by the Contractor and in accordance with the Contractor's grading design drawings. The elevations will be reviewed by the Contracting Officer prior to the commencement of any work activity. The Contractor will provide access to the locations as necessary for the prosecution of the work.

1.10 SEQUENCING AND SCHEDULING

1.10.1 Schedule of Drilling, Sampling, Test Pits and Testing

The Contractor shall submit to the Contracting Officer a schedule of Drilling, Sampling, Test Pits and Testing in form of the following table for approval prior to the commencement of Work.

The schedule shall have, as a minimum, the number of borings and test pits as identified. The depths of these explorations shall be sufficient to determine the subsurface conditions within the influence of the structures foundation system and as indicated. The aggregate surfaced roads (gravel roads) shall be designed in accordance with UFC 3-250-09FA Aggregate Surfaced Roads and Airfield Areas utilizing boring information obtained from the site

BUILDING/ STRUCTURE	BORINGS	DEPTH (m)	TOTAL (m)	TEST PITS	FIELD RESISTIVITY

BUILDING/ STRUCTURE	BORINGS	DEPTH (m)	TOTAL (m)	TEST PITS	FIELD RESISTIVITY
LABORATORY INVESTIGATION					
TESTS					
Gradation-ASTM D422					
Atterberg Limits-ASTM D4318					
Moisture Content-ASTM D2216					
Maximum Dry Density-ASTM D1557 or D 648					
Sulfate Content-BS1337, Part 3 CL 5, 7, and 9					
Gypsum Content-BS 1337					
Organic Content-BS 1337, Part 3, CL 3					
Totals					

1.11 Permits, Certifications, and Licenses

All permits, certifications and licenses required to complete this work shall be procured by the Contractor prior to commencement of construction.

PART 2 PRODUCTS

2.1 CONTAINERS

The Contractor shall furnish sample bags that meet the following requirements. All such containers will become the property of the Government and the cost thereof shall be included in the contract price for the work performed.

2.1.1 Sample Bags

Sample bags shall be 1.0 L capacity, heavy gage, zip-lock resealable plastic bags.

2.1.2 Bulk Sample Bags

Bulk sample bags shall be heavy gauge plastic or fabric capable of holding 25 kg of material

2.1.3 Shipping Boxes

Boxes for shipping samples shall be plastic or wooden boxes as approved by the Contracting Officer that have strength to contain and protect the bags and their contents under ordinary handling and environmental conditions.

2.2 LABELS

2.2.1 Sample Bags

The following information shall be hand written in indelible ink on each bag:

DATE _____
PROJECT _____ LOCATION _____
(Such as Table Rock Dam) (Such as Borrow Area B)

HOLE NO. _____ STATION _____

SAMPLE NO. _____

SPT 'N' COUNT _____ DEPTH OF SAMPLE _____

DESCRIPTION OF MATERIAL _____
(Such as Moist, silty, medium sand)

2.2.2 Shipping Box Labels

Each box of samples shall be identified with weatherproof and wear-proof labels indicating the following:

PROJECT: _____

LOCATION: _____

SAMPLES FROM HOLE OR HOLES: _____

2.3 Geotechnical Report

The Contractor shall submit a draft and final geotechnical report. The Contractor shall produce a detailed geotechnical report containing the field exploration and testing results, laboratory testing results, survey information, evaluations, recommendations, calculations and descriptive supporting text. Information in the report shall include, but not be limited to: existing geotechnical (e.g., surface and subsurface) conditions, location of subsurface explorations, field tests and samples, exploration logs, laboratory data, site development recommendations, foundations recommendations: type of foundation system, for shallow foundation to include minimum depth, bearing capacity, settlement analysis, liquefaction potential, chemical analyses and discussion of corrosion potential, cut and cover guidance, ground water levels, pavement design criteria (CBR and k values), compaction requirements, drainage and/or excavation problems and/or requirements, lateral earth pressure

coefficients (K0, Ka, Kp) and construction material recommendations (e.g., concrete, cement, asphalt and aggregates).

The Contractor shall submit 2 hard copies and 1 soft copy (PDF format) of the draft Geotechnical Report to the Contracting Officer no later than 30 days after completion of field work. The Contracting Officer will provide comments on the draft report within 7 days after receiving of draft report. The Contractor shall address the Contracting Officer's comments and submit 10 hard copies and 2 soft copies (PDF Format) of the final report and annotated comments within 10 days after receipt of Contracting Officer's comments on the draft report. The final report shall be stamped by a professional engineer, professional geologist, or equivalent, indicating the report has been developed consistent with the site-specific geotechnical conditions

PART 3 EXECUTION

3.1 General Scope and Description

The work will consist of borings, standard penetration test (SPT) and test pits in the quantity and depth as indicated as a minimum on the drawings; specified by the contracting officer or as indicated herein. The work will also include performing 4 field resistivity tests and supporting laboratory analyses of collected samples. Representative of the materials encountered will be obtained. Drilling operations and test pit excavation will be accomplished by a local drilling company and observed by a Geotechncial Engineer or Engineering Geologist.

3.2 MOBILIZATION AND DEMOBILIZATION

3.2.1 Mobilization

Mobilization shall consist of the delivery to the site of all plant, equipment, materials and supplies to be furnished by the Contractor, the complete assembly in satisfactory working order of all such plant and equipment at the jobsite and the satisfactory storage at the site of all such materials and supplies.

3.2.2 Demobilization

Demobilization shall consist of the removal from the site of all plant, equipment, materials and supplies after completion of the work and also includes, at the direction of the Contracting Officer, the cleanup and removal of all scrap, waste backfill material, waste drilling fluid, soil contaminated with engine/hydraulic oil, backfilling all sumps or excavations resulting from the operations and, in general, returning the site as close to its original condition as possible.

3.3 EXPLORATORY BORING AND SAMPLING

3.3.1 Equipment

The equipment to be furnished by the Contractor for making borings shall be capable of advancing a hole, not less than 100 mm in diameter unless otherwise approved. The Contractor shall be completely equipped with all the accessories necessary for boring and sampling of overburden materials using split barrel, ring lined barrel and thin-walled tube samplers to the depths and diameters specified or shown on the drawings.

3.3.2 Sampling

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Samples shall be obtained for each change of overburden material and at maximum vertical intervals of 1.5 m. In order to retain the natural moisture content of the material to the fullest extent possible, all samples shall be placed in the sample bags as soon as possible after they are taken from the hole. All sample bags shall be labeled. In general, no sample shall remain on the site of boring for more than 1 week after being taken from the boring and placed in a bag. Samples will be shipped to a local laboratory certified by USACE or to a USACE certified Middle East regional laboratory if special testing is required.

3.3.3 Boring Procedures

a. The locations of the borings will be surveyed prior to commencement of the geotechnical investigation.

b. Boreholes will be advanced at locations shown on the Drawings.

c. The boreholes will be advanced using a machine powered drill capable of drilling to a minimum depth of 15 meters below existing ground surface

d. Material encountered within the borings will be sampled at 1.5 meter intervals using a Standard Penetration Test (SPT) sampler in accordance with ASTM D 1586.

e. The material sampled will be retained for laboratory tests to characterize the physical and engineering properties of the soil.

f. Groundwater levels within the borings will be measured as required.

g. When the borings are completed and the required samples taken and approved by the Geotechnical Engineer, it will be backfilled and compacted accordance with the paragraph BACKFILLING so as not to cause a hazardous condition. Borings will not be left open overnight without prior approval.

3.4 IDENTIFYING SAMPLES

Sample bags, shipping boxes, and labels shall comply with paragraph CONTAINERS and paragraph LABELS. The Contractor shall take all precautions required to insure that the shipping boxes are not subjected to rough handling or damaging environmental conditions, and complies with paragraph CARE AND DELIVERY OF SAMPLES.

3.5 TEST PIT EXCAVATION AND SAMPLING

3.5.1 Excavation

The test pits shall be excavated as identified in paragraph Schedule of Drilling, Sampling, Test Pits and Testing. Before excavating pits, the Contractor shall thoroughly familiarize himself with work site and with all available subsurface data, particularly groundwater conditions.

Selection of the test pit excavation, shoring/lining and dewatering (if necessary) methods and equipment shall be at the Contractor's discretion but must be approved by the Contracting Officer. Accessories to be

supplied by the Contractor shall include, but not be limited to, heavy gage 1 liter capacity zip-lock, resealable plastic bags for collecting samples and bulk sample bags. The Contractor shall also provide all materials required for shoring/lining to comply with all applicable safety regulations. The Contractor may salvage and re-use this shoring/lining material in successive test pits upon inspection and approval by the Contracting Officer.

3.5.2 Test Pit Procedures

a. The locations of the test pits will be surveyed prior to commencement of the geotechnical investigation.

b. Test pits will be excavated by hand or power machine at locations shown on the location plan to a depth of 3.0 meters.

c. Dimensions of the test pits will be such that a 25 kg sample of all representative materials encountered can be obtained at depths specified by the Engineering Geologist.

d. The material sampled will be retained for laboratory tests to characterize the physical and engineering properties of the soil.

e. When the test pit is completed and the required samples taken and approved by the Geotechnical Engineer, it will be backfilled and compacted in accordance with the paragraph BACKFILLING so as not to cause a hazardous condition. Test pits will not be left open overnight without prior approval.

3.5.3 Sampling

Soil samples shall be obtained from each pit at depths determined by the Contracting Officer in accordance with paragraph Test Pit Procedures. The number of samples required will be as indicated in paragraph Schedule of Drilling, Sampling, Test Pits and Testing.

3.5.4 Disposition of Samples

Samples shall be packed as approved by the Contracting Officer and shipped in sturdy wooden or plastic boxes of strength and construction sufficient to guarantee against damage during shipment. All sample boxes shall be marked FRAGILE-HANDLE WITH CARE and shall be identified by labels, similar to those as specified in paragraph IDENTIFYING SAMPLES, attached to the outside of each box. Extreme care shall be taken to indicate the top and bottom of each sample. The Contractor shall avoid exposing sealed and crated samples to precipitation and extremes of temperature. Prior to shipment, each sealed and boxed sample shall be checked for correct labeling. Samples will be shipped to a local laboratory certified by USACE or to a USACE certified Middle East regional laboratory if special testing is required.

3.6 FIELD RESISTIVITY TESTS

Conduct tests using a 4 point Wenner Array or approved equal at locations listed in paragraph 3.1.

3.7 BACKFILLING

3.7.1 Exploratory Borings

Unless otherwise noted in these specifications or directed by the Contracting Officer, all bore holes shall be backfilled and abandoned in in a timely manner. The Contractor shall preserve all holes in good condition until final measurement and until the records and samples have been accepted. The hole shall be backfilled with local soil and tamped. All backfilling operations shall be performed in the presence of the Contracting Officer. No separate payment will be made for backfilling drill holes. The cost of this work shall be included in the drilling costs.

3.7.2 Test Pits

The Contractor shall backfill all test pits with local soil compacted to original densities as directed by the Contracting Officer. No separate payment will be made for backfilling test pits. The cost of this work shall be included in the test pit excavation costs.

3.8 RECORDS

The Contractor shall keep accurate Driller's Logs and records of all work accomplished under this contract and shall deliver complete, legible copies of these logs and records to the Contracting Officer upon completion of the work or at such other time or times as he may be directed. All such records shall be recorded during the actual performance of the work and shall be preserved in good condition and order by the Contractor until they are delivered and accepted. The Contracting Officer shall have the right to examine and review all such records at any time prior to their delivery to him and shall have the right to request changes to the record keeping procedure. The following information shall be included on the logs or in the records for each hole and test pit:

a. Exploratory boring/Test Pit number or designation and elevation of top of hole/test pit.

b. Driller's name and Geologist's name.

c. Make, size, and manufacturer's model designation of drilling,sampling, and test-pit excavating equipment.

d. Type of drilling, and sampling operation by depth.

e. Hole diameter.

f. Dates and time by depths when test-pit excavation, drilling, and sampling operations were performed.

g. Depths at which samples were recovered or attempts made to sample.

h. Classification or description by depths of the materials sampled, using the Unified Soil Classification System (ASTM D 2487) and including a description of moisture conditions, consistency and other appropriate descriptive information. This classification or description shall be made immediately after the samples or cores are retrieved.

i. Depth at which groundwater is encountered initially and when

stabilized.

j. Depth of bottom of hole.

3.9 LABORATORY TESTING

All laboratory testing will be performed by a laboratory certified by USACE and in accordance with ASTM or other recognized standards and procedures as approved by the Contracting Officer in cases where there are no ASTM standards assigned to a particular test. Test requirements will include the following:

a. Gradation - ASTM D 422

b. Atterberg Limits - ASTM D 4318

c. Moisture Content - ASTM D 2216

d. CBR - ASTM D 1883

e. Sulfate - ASTM C 1580

f. Gypsum Content - BS 1377, Part 3

g. Organic Content - ASTM D 2974

h. Maximum Dry Density - ASTM D 1883

i. Field Resistivity Survey - ASTM G 57

-- End of Section --

SECTION 03 11 13.00 10

STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

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 347	(2004; Errata 2008) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood

ASTM INTERNATIONAL (ASTM)

ASTM C 1077	(2010c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 31/C 31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

1.2 SYSTEM DESCRIPTION

The design, engineering, and construction of the formwork is the responsibility of the Contractor. Design formwork in accordance with methodology of ACI 347 for anticipated loads, lateral pressures, and stresses, and capable of withstanding the pressures resulting from placement and vibration of concrete. Comply with the tolerances specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE, paragraph CONSTRUCTION TOLERANCES. However, for surfaces with an ACI Class A surface designation, limit the allowable deflection for facing material between studs, for studs between walers and walers between bracing to 0.0025 times the span. Design the formwork as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. Monitor the adequacy of formwork design and construction prior to and during concrete placement as part of the Contractor's approved Quality

Control Plan.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Formwork; G

SD-03 Product Data

Design
Form Materials
Form Releasing Agents

SD-06 Test Reports

Inspection
Formwork Not Supporting Weight of Concrete; G.

PART 2 PRODUCTS

2.1 FORM MATERIALS

Submit manufacturer's data, including literature describing form materials, accessories, and form releasing agents.

2.1.1 Forms For Class B Finish

This class of finish shall apply to all surfaces except those specified to receive Class C. Forms for Class B finished surfaces shall be plywood panels conforming to APA PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Steel lining on wood sheathing will not be permitted.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to APA PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Provide solid backing for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Terminate the

embedded portion of metal ties not less that 50 mm from any concrete surface exposed to water. Removable tie rods shall be not more than 38 mm in diameter. Plastic snap ties may be used in locations where the surface will not be exposed to view.

2.1.4 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, follow the recommendation of the form coating manufacturer. Submit manufacturer's recommendation on method and rate of application of form releasing agents.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be constructed true to the structural design and required alignment. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE and conforming to construction tolerance given in TABLE 1. Continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class specified. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker. Submit drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

3.2 CHAMFERING

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated 300 mm outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.3 COATING

Forms for Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or

written instructions. Forms for Class C finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time, minimum ambient temperature, and minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as specified in Section 03 35 00.00 10. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M at the expense of the Contractor by an independent laboratory that complies with ASTM C 1077 and shall be tested within 4 hours after removal from the site.

3.4.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed.

3.4.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders indicate evidence the concrete has attained at least 75 percent of the compressive strength required for the structure in accordance with the quality and location requirements.

3.5 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall

be reported in writing. Submit field inspection reports for concrete forms and embedded items.

TABLE 1 TOLERANCES FOR FORMED SURFACES	
1. Variations from the plumb:	
a. In the lines and surfaces of columns, piers, walls and in arises	6 mm in any 3 m of length Maximum for entire length -- 25 mm
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	6 mm in any 6 m of length Maximum for entire length -- 13 mm
2. Variation for the level or from the grades indicated on the drawings:	
a. In slab soffits, ceilings beam soffits, and in arises,measured before removal of supporting shores	6 mm in any 3 m of length 10 mm in any bay or in any 6 m of length Maximum for entire length -- 20 mm
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	6 mm in any bay or in any 6 m of length Maximum for entire length -- 13 mm
3. Variation of the linear building lines from established position in plan	13 mm in any 6 m 25 mm maximum
4. Variation of distance between walls, columns, partitions	6 mm per 3 m of distance, but not more than 13 mm in any one bay, and not more than 25 mm total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus 6 mm, Plus 13 mm
6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus 6 mm, Plus 13 mm
7. Footings:	
a. Variation of dimensions in plan	Minus 13 mm, plus 50 mm when formed or plus 75 mm when placed against unformed excavation

TABLE 1 TOLERANCES FOR FORMED SURFACES	
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 50 mm
c. Reduction in thickness	Minus 5 percent of the specified thickness
8. Variation in steps:	
a. In a flight of stairs	Riser -- 3 mm Tread -- 6 mm
b. In consecutive steps	Riser -- 2 mm Tread -- 3 mm

-- End of Section --

SECTION 03 15 00.00 10

CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

ASTM INTERNATIONAL (ASTM)

ASTM C 919	(2008) Use of Sealants in Acoustical Applications
ASTM C 920	(2010) Standard Specification for Elastomeric Joint Sealants
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 2628	(1991; R 2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 2007) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 471	(2010) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D 5249	(1995; R 2006) Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications

for Polyvinylchloride Waterstops

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Waterstops; G

SD-03 Product Data

Preformed Expansion Joint Filler
Sealant
Waterstops

SD-04 Samples

Lubricant for Preformed Compression Seals
Field-Molded Type
Non-metallic Materials
Waterstops
Splicing Waterstops; G

SD-07 Certificates

Preformed Expansion Joint Filler
Sealant
Waterstops

1.3 DELIVERY, STORAGE, AND HANDLING

Protect material delivered and placed in storage off the ground from moisture, dirt, and other contaminants. Deliver sealants in the manufacturer's original unopened containers. Remove sealants from the site whose shelf life has expired.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752, Type I, or resin impregnated fiberboard conforming to the physical requirements of ASTM D 1752. Submit certified manufacturer's test reports for premolded expansion joint filler strips, compression seals and lubricant, and metallic waterstops to verify compliance with applicable specification. Unless otherwise indicated, filler material shall be 10 mm

thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835. Submit a piece not less than 3 m of 25 mm nominal width or wider seal or a piece not less than 4 m of compression seal less than 25 mm nominal width. Provide one L of lubricant.

2.3.3 Field-Molded Type

ASTM C 920. Sealant shall be Type M, Grade P or NS, Class 25, Use T for horizontal joints. Type M, Grade NS, Class 25, Use NT for vertical joints. Except, the joint sealant that will be submerged underwater for part or all of its service life shall meet the requirements of USE I. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber. Submit Four liters of field-molded sealant and one L of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

2.4 WATERSTOPS

Shop fabricate intersection and change of direction waterstops. Submit a sample of each material consisting of a piece not less than 300 mm long cut from each 60 m of finished waterstop furnished, but not less than a total of 1.2 linear meters of each type and size furnished. For spliced segments of waterstops to be installed in the work, furnish one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site for inspection and testing. Make the spliced samples using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each spliced sample shall be not less than 300 mm long. Submit waterstop materials and splice samples for inspection and testing identified to indicate manufacturer, type of material, size and quantity of material and shipment represented.

2.4.1 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471. Submit a piece not less than 300 mm long cut from each 61 m of finished waterstop furnished, but not less than a total of 1 m of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. Make the

splice samples using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 300 mm long.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

2.5.1 Materials Tests

2.5.1.1 Field-Molded Sealants

Samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in paragraph FIELD MOLDED TYPE, shall be tested by and at the expense of the Government for compliance with paragraph FIELD MOLDED TYPE. If the sample fails to meet specification requirements, provide new samples and the cost of retesting will be deducted from payments due the Contractor at a rate set by the Contracting Officer.

2.5.1.2 Non-Metallic Waterstops

Samples of materials and splices will be visually inspected and tested by and at the expense of the Government for compliance with COE CRD-C 513 or COE CRD-C 572 as applicable. If a sample fails to meet the specification requirements, provide new samples and the cost of retesting will be deducted from payments due the Contractor at the rate set by the Contracting Officer.

2.5.2 Splicing Waterstops

2.5.2.1 Procedure and Performance Qualifications

Demonstrate procedure and performance qualifications for splicing waterstops in the presence of the Contracting Officer. Submit procedures for splicing waterstops for approval.

2.5.2.2 Non-Metallic Waterstops

Demonstrate procedure and performance qualifications for splicing non-metallic waterstops by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

PART 3 EXECUTION

3.1 INSTALLATION

Joint locations and details, including materials and methods of installation of joint fillers and waterstops, shall be as specified and indicated. In no case shall any fixed metal be continuous through an expansion or contraction joint.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Make joints 3 mm to 5 mm wide and extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm.

3.1.1.1 Joint Strips

Provide strips of the required dimensions and as long as practicable. After the first floating, groove the concrete with a tool at the joint locations. Insert the strips in the groove and depress them until the top edge of the vertical surface is flush with the surface of the slab. Float and finish the slab as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, saw out the top portion of the strip after the curing period to form a recess for sealer. Discard the removable section of PVC or HIPS strips and leave the insert in place. Maintain true alignment of the strips during insertion.

3.1.1.2 Sawed Joints

Saw joints early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Use concrete sawing machines that are adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Cut joints to true alignment and in sequence of concrete placement. Remove sludge and cutting debris. Form reservoir for joint sealant.

3.1.1.3 Bond Breaker

Coat joints requiring a bond breaker with curing compound or with bituminous paint. Protect waterstops during application of bond breaking material to prevent them from being coated.

3.1.2 Expansion Joints

Use preformed expansion joint filler in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. Extend the filler to the full slab depth, unless otherwise indicated. neatly finish the edges of the joint with an edging tool of 3 mm radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. Remove the wood strip after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. Thoroughly clean the groove of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust. If blowing out the groove use oil-free compressed air.

3.1.3 Joint Sealant

Fill sawed contraction joints and expansion joints in slabs with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Apply joint sealant as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Install compression seals with equipment capable of installing joint seals

to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. Cover the sides of the joint and, if necessary, the sides of the compression seal with a coating of lubricant. Coat butt joints with liberal applications of lubricant.

3.1.3.2 Joints With Field-Molded Sealant

Do not seal joints when the sealant material, ambient air, or concrete temperature is less than 4 degrees C. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Coat joints requiring a bond breaker with curing compound or with bituminous paint. Install bond breaker and back-up material where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Install waterstops at the locations shown to form a continuous water-tight diaphragm. Embed the bottom of each waterstop a minimum of 150 mm in firm rock or sealed to other cut-off systems. Make adequate provision to support and completely protect the waterstops during the progress of the work. Repair or replace any waterstop punctured or damaged. Protect exposed waterstops during application of form release agents to avoid being coated. Provide suitable guards to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Accomplish splices with certified trained personnel using approved equipment and procedures.

3.2.1 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Maintain continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) across the splice.

3.2.1.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.1.2 Polyvinyl Chloride Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Use the correct temperature to sufficiently melt without charring the plastic. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.1.3 Quality Assurance

Edge welding will not be permitted. Compress or close centerbulbs when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 2 mm or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.2 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 25 mm overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Treat construction joints coinciding with expansion and contraction joints as expansion or contraction joints as applicable.

-- End of Section --

SECTION 03 20 00.00 10

CONCRETE REINFORCING

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 318M	(2008; Errata 2010) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 1035/A 1035M	(20009) Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A 184/A 184M	(2006) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 370	(2010) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 53/A 53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(2003; R 2009) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2009; 28th Ed) Manual of Standard Practice

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007; Change 1) Seismic Design for Buildings

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Reinforcement; G

SD-03 Product Data

Butt-Splices; G
Material; G

SD-06 Test Reports

Material; G
Tests, Inspections, and Verifications; G

SD-07 Certificates

Reinforcing Steel

1.3 DELIVERY, STORAGE, AND HANDLING

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80 or ASTM A 1035/A 1035M. Steel pipe conforming to ASTM A 53/A 53M, Schedule 80, may be used as dowels provided the ends are closed with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M, ASTM A 706/A 706M grades and sizes as indicated.

Submit certified copies of mill reports attesting that the reinforcing

steel meets the requirements specified herein, prior to the installation of reinforcing steel.

2.3.1 Reinforcing in Command and Control Center

If ASTM A 615/A 615M reinforcing steel to be used, ASTM A615/A615M reinforcement for these buildings shall conform to the requirements of ACI 318M 21.1.5.2 as follows

a. The actual yield strength based upon mill tests does not exceed fy by more than 125 MPa.

b. The ratio of the actual tensile strength to the actual yield strength is not less than 1.25.

2.4 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.5 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks.

Bar supports shall comply with the requirements of ACI SP-66. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than 90 by 90 mm, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.6.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with ASTM A 370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318M. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.1.3 Placing Tolerances

3.1.3.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 25 mm.

3.1.3.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

MINIMUM COVER (mm)	VARIATION (mm)
150	plus 13
100	plus 10
75	plus 10
50	plus 6
38	plus 6
25	plus 3
19	plus 3

3.1.4 Splicing

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government subject to approval.

3.1.4.1 Lap Splices

Lap splices shall be used only for bars smaller than size 45. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 150 mm.

3.1.4.2 Butt-Splices

Use butt-splices only for splicing size 45 and 55 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Butt-splices shall develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Bars shall be cleaned of all oil, grease, dirt, rust, scale and other foreign substances and shall be flame dried before splicing. Adequate jigs and clamps or other devices shall be provided to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Properties and analyses of steel bars and splicing materials shall be included in the submitted procedure. Physical properties of splicing sleeves shall include length, inside and outside diameters, and inside surface details.. Butt-splices shall be as follows:

b. Mechanical Butt-Splices - Mechanical butt-splices shall be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Surfaces to be enclosed within a splice sleeve or coupling shall be cleaned by wire brushing or other approved method prior to splicing.

Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. In addition to the strength requirements specified paragraph BUTT-SPLICES the additional deformation of number 45 and smaller bars due to slippage or other movement within the splice sleeve shall not exceed 0.38 mm (unit strain 0.0015 mm/mm) beyond the elongation of an unspliced bar based upon a 250 mm gage length spanning the extremities of the sleeve at a stress of 200 MPa. The additional deformation of number 55 bars shall not exceed 0.75 mm (unit strain 0.003 mm/mm) beyond the elongation of an unspliced bar based upon a 250 mm gage length spanning the extremities of the sleeve at a stress of 200 MPa. The amount of the additional deformation shall be determined from the stress-strain curves of the unspliced and spliced bars tested as required paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure. Tension splices of number 45 or smaller bar shall be staggered longitudinally a minimum of 1500 mm or as otherwise indicated so that no more than half of the bars are spliced at any one section. Tension splices of number 55 bars shall be staggered longitudinally a minimum of 1500 mm so that no more than 1/3 of the bars are spliced at any one section.

3.2 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.3 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with UFC 3-310-04 and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.

3.4.2 Examining, Testing, and Correcting

Perform the following during the butt-splicing operations as specified and as directed:

b. Tension Tests - Tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction shall be performed on one test specimen made in the field for every 25 splices made. Test specimens shall be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Stress-strain curves shall be furnished for each butt-splice tested.

d. Correction of Deficiencies - No splice shall be embedded in concrete until satisfactory results of visual examination and the

required tests or examinations have been obtained. All splices having visible defects or represented by test specimens which do not satisfy the tests or examinations shall be removed. If any of the tension test specimens fail to meet the strength requirements or deformation limitations two production splices from the same lot represented by the test specimens which failed shall be cut out and tension tested. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. All costs of removal, testing and resplicing of the additional production splices shall be borne by the Contractor. The bars of rejected splices shall be cut off outside the splice zone of weld metal, filler metal contact, coupling or sleeve. The cut ends shall be finished as specified and the joints shall be respliced and reinspected at no additional cost.

e. Supplemental Examination - The Contracting Officer may require additional tension test of any completed splice.

-- End of Section --

SECTION 03 30 00.00 10

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 LUMP SUM CONTRACT

Under this type of contract, concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.2 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 117	(2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 214R	(2002; Errata 2010) Evaluation of Strength Test Results of Concrete
ACI 305.1	(2006) Specification for Hot Weather Concreting
ACI 318M	(2008; Errata 2010) Building Code Requirements for Structural Concrete & Commentary

ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059/C 1059M	(1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1077	(2010c) Standard Practice for Laboratories

	Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 1567	(2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 173/C 173M	(2010b) 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 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 31/C 31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2010) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2010a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation

ASTM C 578	(2010) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2009) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(2010) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 94/C 94M	(2010) Standard Specification for Ready-Mixed Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C78/C78M	(2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM D 75/D 75M	(2009) Standard Practice for Sampling Aggregates
ASTM E 1155M	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2010) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(2000; R 2006) Concrete Plant Standards
NRMCA QC 3	(2003) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(2001; R 2007) Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the

	Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 94	(1995) Corps of Engineers Specification for Surface Retarders

1.3 SYSTEM DESCRIPTION

Provide concrete composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.3.1 Proportioning Studies-Normal Weight Conc

Trial design batches, mixture proportions studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based 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.

a. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications.

b. Make trial mixtures having proportions, consistencies, and air content suitable for the work based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project.

c. The maximum water-cement ratios required in subparagraph Water-Cement Ratio below will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus silica fume by the weight equivalency method as described in ACI 211.1. In the case where silica fume is used, the weight of the silica fume shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan.

d. Design laboratory trial mixtures for maximum permitted slump and air content. Make separate sets of trial mixture studies for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations.

e. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age shall be made, cured in accordance withASTM C 192/C 192M and tested at

7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Design each mixture to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

f. Submit the results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. Accompany the statement with test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

1.3.2 Proportioning Studies-Flexural Strength Conc

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete above, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C78/C78M. Modify procedures given in ACI 211.1 as necessary to accommodate flexural strength.

1.3.3 Average Compressive Strength

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, adjust the mixture, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.3.4 Computations from Test Records

Where a concrete production facility has test records, establish a standard deviation in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

f'cr = f'c + 1.34S where units are in MPa

f'cr = f'c + 2.33S - 3.45 where units are in MPa

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.3.5 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 20 MPa,

   f'cr = f'c + 6.9 MPa

b. If the specified compressive strength f'c is 20 to 35 MPa,

   f'cr = f'c + 8.3 MPa

c. If the specified compressive strength f'c is over 35 MPa,

   f'cr = f'c + 9.7 MPa

1.3.6 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.3.7 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117. Take level and grade tolerance measurements of slabs as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.3.8 Floor Finish

For the purpose of this Section the following terminology correlation between ACI 117 and this Section shall apply:

Floor Profile Quality Classification From ACI 117	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance does not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.3.8.1 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.8.5 and 4.8.5.1 of ACI 117. Furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155M. Perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of ASTM E 1155M (the areas within 600 mm of embedments and construction joints) will be acceptable to the Contracting Officer. Tolerances of all exposed floors shall meet the requirements for the trowel finish as specified in paragraphs 4.8.5 and 4.8.5.1 of ACI 117.

1.3.9 Strength Requirements

Specified compressive strength (f'c) shall be 27.5 MPa at 28 days.:

Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C78/C78M.

a. Evaluation of Concrete Compressive Strength. Fabricate compressive strength specimens (152 by 305 mm cylinders), laboratory cure them in accordance with ASTM C 31/C 31M and test them in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing,

take steps to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. Perform the coring and repair the holes; cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318M. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Fabricate flexural strength specimens (beams) laboratory cure them in accordance with ASTM C 31/C 31M and test them in accordance with ASTM C78/C78M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.3.10 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall not exceed 0.45.

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus silica fume by the weight equivalency method as described in ACI 211.1. In the case where silica fume is used, the weight of the silica fume shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.3.11 Air Entrainment

Except as otherwise specified for lightweight concrete, all normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 19 mm or

smaller it shall be between 4.5 and 7.5 percent. Concrete with specified strength over 35 MPa may have 1.0 percent less air than specified above. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C231/C231M. Entrained air is not to be used for concrete to be given a smooth, dense, hard-troweled finish, and the total air in these batches shall not exceed 3 percent.

1.3.12 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	50 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added.

1.3.13 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

1.3.14 Size of Coarse Aggregate

Use the largest feasible nominal maximum size aggregate (NMSA), specified in PART 2 paragraph AGGREGATES, in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Portland Cement
Ready-Mixed Concrete
Vapor Barrier
Latex Bonding Agent
Floor Finish
Floor Hardener
Chemical Admixtures
Epoxy Resin

SD-04 Samples

Surface Retarder

SD-05 Design Data

Mixture Proportions; G

SD-06 Test Reports

Testing and Inspection for CQC; G

SD-07 Certificates

Qualifications

1.5 QUALITY ASSURANCE

Submit qualifications for Contractor Quality Control personnel assigned to concrete construction as American Concrete Institute (ACI) Certified Workmen in one of the following grades or show written evidence of having completed similar qualification programs:

Concrete Field Testing Technician	Grade I
Concrete Laboratory Testing Technician	Grade I or II
Concrete Construction Inspector	Level II
Concrete Transportation Construction Inspector or Reinforced Concrete Special Inspector	Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Code Council (ICC), and Southern Building Code Congress International (SBCCI)

Foreman or Lead Journeyman of the flatwork finishing crew	Similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation

1.5.1 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.5.2 Government Assurance Inspection and Testing

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any CQC responsibilities.

1.5.2.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75/D 75M. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.5.2.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C172/C172M and tested in accordance with these specifications, as considered necessary.

1.5.2.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.5.2.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

Store cement and other cementitious materials in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer

is left undisturbed. Store reinforcing bars and accessories above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement in combination with silica fume conforming to appropriate specifications listed below. Restrict usage of cementitious materials in concrete that will have surfaces exposed in the completed structure so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150/C 150M, Type I with a maximum 15 percent amount of tricalcium aluminate or Type V. The cementitious material content shall not be less than 390 kg/cubic meter.

2.1.2 Silica Fume

Silica fume shall conform to ASTM C 1240. Available alkalis shall conform to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. In accordance with paragraph Technical Service for Specialized Concrete in PART 1, provide at no cost to the Government the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. The cementitious material shall consist of portland cement with a 7.0 to a 9.0 percent by mass replacement of cement by silica fume.

2.2 AGGREGATES

Fine and coarse aggregates shall "be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C 1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing using ASTM C 1260 and ASTM C 1567 shall be performed. The additional testing using ASTM C 1260 and ASTM C 1567 shall be performed using the low alkali portland cement.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33/C 33M.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33/C 33M, Class 5S. Maximum aggregate size of 19 mm

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies. The dosage of the HRWRA shall be determined during the mixture proportioning study.

2.3.5 Surface Retarder

COE CRD-C 94. Submit sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 WATER

Water for mixing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.5 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107/C 1107M, and shall be a commercial formulation suitable for the proposed application.

2.6 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059/C 1059M.

2.7 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881/C 881M, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures. Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the items above, including printed instructions.

2.8 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09 51 00 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.9 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.10 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV.

2.11 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.25 mm or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per Pascal per second per square meter as determined in accordance with ASTM E 96/E 96M.

2.12 JOINT MATERIALS

2.12.1 Joint Fillers, Sealers, and Waterstops

Materials for expansion joint fillers and waterstops shall be in accordance with Section 03 15 00.00 10 CONCRETE ACCESSORIES. Materials for and sealing of joints shall conform to the requirements of Section 07 92 00 JOINT SEALANTS.

2.12.2 Contraction Joints in Slabs

Materials for contraction joint inserts shall be in accordance with Section 03 15 00.00 10 CONCRETE ACCESSORIES.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, perform the following: Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03 20 00.00 10 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Keep rock surfaces continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Place concrete before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 31 00 00 EARTHWORK. Place the concrete without becoming contaminated by loose material, and outlined within the specified tolerances.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting,

high-pressure water jet, or other approved method. Prepare concrete at the side of vertical construction joints as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. Keep the surface of horizontal construction joints continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors, a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the 2.36 mm sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 700 kPa, plus or minus 70 kPa, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

Use a stream of water under a pressure of not less than 20 MPa for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Use wet sandblasting after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Remove laitance and loose particles. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Provide vapor barrier beneath the interior on-grade concrete floor slabs. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Place vapor barrier directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, a thin layer of approximately 13 mm of fine graded material should be rolled or compacted over the fill before installation of the vapor barrier to reduce the possibility of puncture. Control concrete placement so as to prevent damage to the vapor barrier.

3.1.4 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 General Requirements

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

3.2.2 Batching Plant

Locate the batching plant offsite close to the project. The batching, mixing and placing system shall have a capacity to meet the demands of the project construction schedule and quantity. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.3 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. Provide a semiautomatic batching system with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. Equip the batching system with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. Record the weight of water and admixtures if batched by weight. Provide separate bins or compartments for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first, except that silica fume shall always be batched separately. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Furnish admixtures as a liquid of suitable concentration for easy control of dispensing. Provide an adjustable, accurate, mechanical device for measuring and dispensing each admixture. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. Arrange the plant so as to facilitate the inspection of all operations at all times. Provide suitable facilities for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.4 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. Provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Perform the tests at the specified frequency in the presence of a Government inspector. Arrange the weighing equipment so that the plant operator can conveniently observe all dials or indicators.

3.2.5 Batching Tolerances

a. Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Tolerances with Volumetric Equipment - For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water	plus or minus 1
Chemical admixture	0 to plus 6

3.2.6 Moisture Control

Provide a plant capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.7 Concrete Mixers

Mixers shall be stationary mixers or truck mixers capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. Operate the mixers at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.8 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or pug mill type provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.2.9 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used

either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved in lieu of this, the number of revolutions shall be marked on the batch tickets. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Transport concrete to the placing site in truck mixers.

3.4 CONVEYING CONCRETE ONSITE

Convey concrete from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. Equip the transfer hopper with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Use nonagitating equipment only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. Use a discharge deflector when required by

the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.4.5 Belt Conveyors

Design and operate belt conveyors to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Construct belt conveyors such that the idler spacing does not exceed 900 mm. The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.5 PLACING CONCRETE

Discharge mixed concrete within 1.5 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, reduce the time to 45 minutes. Place concrete within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Provide adequate scaffolding, ramps and walkways so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities prevent proper consolidation, finishing and curing. Provide sufficient placing capacity so that concrete can be kept free of cold joints.

3.5.1 Depositing Concrete

Deposit concrete as close as possible to its final position in the forms, and with no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single lift. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls

until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for adjoining slabs.

3.5.2 Consolidation

Immediately after placing, consolidate each layer of concrete by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; keep a spare vibrator at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Insert vibrators vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segregation or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.5.3 Cold Weather Requirements

Use special protection measures, approved by the Contracting Officer, if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.5.4 Hot Weather Requirements

When job-site conditions are present or anticipated that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 27 degrees C or higher, and an evaporation rate that exceeds 1 $kg/m^2/h$, concrete work shall conform to all requirements of ACI 305.1.

3.5.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low

humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Take particular care if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Conform with the requirement of ACI 305.1. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.5.6 Placing Concrete in Congested Areas

Use special care to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.5.7 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017/C 1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph SYSTEM DESCRIPTION. Use extreme care in conveying and placing the concrete to avoid segregation. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.6 JOINTS

Locate and construct joints as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, locate such joints near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by

removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07 92 00 JOINT SEALANTS.

3.6.1 Construction Joints

For concrete other than slabs on grade, locate construction joints as indicated in the Drawings only. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Locate construction joints as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, extend reinforcing steel through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, terminate lifts at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Place concrete to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete above.

3.6.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Produce contraction joints by forming a weakened plane in the concrete slab using materials and procedures specified in Section 03 15 00.00 10 CONCRETE ACCESSORIES.

3.6.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03 15 00.00 10 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07 92 00 JOINT SEALANTS.

3.6.4 Waterstops

Install waterstops in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03 15 00.00 10 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.6.5 Dowels and Tie Bars

Install dowels and tie bars at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03 20 00.00 10 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of

1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.7 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 19 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed.

3.7.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.7.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.7.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Discard grout not used within 30 minutes after mixing. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.7.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a

smooth-dense finish and be left untreated. Curing shall comply with Section 03 39 00.00 10 CONCRETE CURING.

3.8 TESTING AND INSPECTION FOR CQC

Perform the inspection and tests described below and, based upon the results of these inspections and tests, take the action required. Submit certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

a. When, in the opinion of the Contracting Officer, the concreting operation is out of control, cease concrete placement and correct the operation.

b. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site.

c. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per month thereafter for conformance with ASTM C 1077.

3.8.1 Grading and Corrective Action

3.8.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall be immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.8.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and

reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.8.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, perform all tests for aggregate quality required by ASTM C 33/C 33M. In addition, after the start of concrete placement, perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.8.3 Scales, Batching and Recording

Check the accuracy of the scales by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.8.4 Batch-Plant Control

Continuously control the measurement of concrete materials, including cementitious materials, each size of aggregate, water, and admixtures. Adjust the aggregate weights and amount of added water as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. Prepare a report indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

3.8.5 Concrete Mixture

a. Air Content Testing. Perform air content tests when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Perform additional tests when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C231/C231M for normal weight concrete and ASTM C 173/C 173M for lightweight concrete. Plot test results on control charts which shall at all times be readily available to the Government and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, perform a second test immediately. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of

each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment in PART 1. Set an upper warning limit and a lower warning limit line 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which are made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Plot test results on control charts which shall at all times be readily available to the Government and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, immediately perform a second test. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Set limits on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Take samples for slump at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, take correlation samples at the

placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, make an adjustment immediately in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, halt the concreting operation immediately, and take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. Measure the temperature of the concrete when compressive strength specimens are fabricated in accordance with ASTM C 1064/C 1064M. Report the temperature along with the compressive strength data.

f. Strength Specimens. Perform at least one set of test specimens, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. Perform additional sets of test specimens, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. Develop a truly random (not haphazard) sampling plan for approval by the Contracting Officer prior to the start of construction. The plan shall ensure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength in accordance with paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C78/C78M for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214R.

3.8.6 Inspection Before Placing

Inspect foundations, construction joints, forms, and embedded items in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. Report the results of each inspection in writing.

3.8.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of

placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.8.8 Vibrators

Determine the frequency and amplitude of each vibrator in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Perform additional tests as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. Determine the amplitude with the head vibrating in air. Take two measurements, one near the tip and another near the upper end of the vibrator head, and these results averaged. Report the make, model, type, and size of the vibrator and frequency and amplitude results in writing. Any vibrator not meeting the requirements of paragraph Consolidation above, shall be immediately removed from service and repaired or replaced.

3.8.9 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.8.10 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. Select the truck mixers randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.8.11 Reports

Report all results of tests or inspections conducted, informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation

to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 03 35 00.00 10

CONCRETE FINISHING

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 117	(2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 305R	(2010) Specification for Hot Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM C 1059/C 1059M	(1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 881/C 881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.2 SUBMITTALS

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

SD-03 Product Data

Latex Bonding Compound
Epoxy Resin

1.3 QUALITY ASSURANCE

1.3.1 Field Test Panels

Construct field test panels prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, construct additional panels until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

1.3.1.1 Slab Panels

A slab panel at least 1220 mm by 1525 mm and 100 mm thick shall be constructed to demonstrate exposed aggregate slab finish and a similar panel for extra high class slab finish. Each panel shall have a full length joint line. All field test panels are not to be used as part of the final structure.

PART 2 PRODUCTS

2.1 LATEX BONDING COMPOUND

Latex bonding compound agents for bonding fresh to hardened concrete shall conform to ASTM C 1059/C 1059M. Submit samples as required.

2.2 EPOXY RESIN

Epoxy resin for use in repairs shall conform to ASTM C 881/C 881M, Type III, Grade I or II. Submit samples as required.

PART 3 EXECUTION

3.1 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired.

Maintain uniform color of the concrete by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class B finish. The form panels used to produce the finish shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features. Forms shall not be reused if there is any evidence of surface wear or defects that would impair the quality of the surface.

3.1.1 Class B Finish

Class B finish is required in the following areas, exposed concrete vertical surfaces. Remove fins, ravelings, and loose material, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. Prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained.

3.1.2 Class C Finish

Class C finish is required in the following areas, non-exposed concrete vertical surfaces. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or

more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

3.2 REPAIRS

Except for major defects, as defined hereinafter, repair surface defects as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair below. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects below. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.2.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects, whose depth is at least as great as their surface diameter but not over 100 mm, shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm sieve, and minimum amount of water. Use only sufficient water to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.2.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class B finishes, more than 12 mm in diameter and, for Class C finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Repair major defects as specified below.

3.2.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Use approved equipment and procedures which

will not cause cracking or microcracking of the sound concrete. If reinforcement is encountered, remove concrete so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Keep surfaces continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, as an option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, test each repair area for drumminess by firm tapping with a hammer and inspecting for cracks, both in the presence of the Contracting Officer, immediately before completion of the contract, and replacing any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Keep burlap continually wet.

3.3 FORMED SURFACE REPAIR

After removal of forms, all ridges, lips, and bulges on surfaces permanently exposed shall be removed. All repairs shall be completed within 48 hours after form removal.

3.3.1 Classes B Finishes

Surfaces listed in Section 03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING and as shown to have classes B finishes shall have surface defects repaired as follows: defective areas, voids, and honeycombs smaller than 10 000 square mm in area and less than 13 mm deep and bug holes exceeding 13 mm in diameter shall be chipped and filled with dry-packed mortar. Holes left by removal of tie rods shall be reamed and filled with dry-packed mortar as specified in paragraph MATERIAL AND PROCEDURE FOR REPAIRS below. Defective and unsound concrete areas larger than described shall be defined by 13 mm deep dovetailed saw cuts in a rectangular pattern with lines parallel to the formwork, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN in PART 2, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND in PART 2, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph

MATERIAL AND PROCEDURE FOR REPAIRS below.

3.3.2 Class C Finish

Surfaces listed in Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK and as shown shall have defects repaired as follows: defective areas, voids, and honeycombs smaller than 15 000 square mm and less than 50 mm deep; bug holes exceeding 38 mm in diameter shall be chipped and filled with dry-packed mortar; and holes left by removal of the tie rods shall be chipped and filled with dry-packed mortar. Defective and unsound concrete areas larger than 15 000 square mm and deeper than 38 mm shall be defined by 13 mm deep dovetailed saw cuts in a rectangular pattern, the defective concrete removed by chipping, and the void repaired with replacement concrete. The prepared area shall be brush-coated with an epoxy resin meeting the requirements of paragraph EPOXY RESIN in PART 2, a latex bonding agent meeting the requirements of paragraph LATEX BONDING COMPOUND in PART 2, or a neat cement grout after dampening the area with water. The void shall be filled with replacement concrete in accordance with paragraph MATERIAL AND PROCEDURE FOR REPAIRS below.

3.3.3 Material and Procedure for Repairs

The cement used in the dry-packed mortar or replacement concrete shall be a blend of the cement used for production of project concrete and white portland cement properly proportioned so that the final color of the mortar or concrete will match adjacent concrete. Trial batches shall be used to determine the proportions required to match colors. Dry-packed mortar shall consist of one part cement to two and one-half parts fine aggregate. The fine aggregate shall be that used for production of project concrete. The mortar shall be remixed over a period of at least 30 minutes without addition of water until it obtains the stiffest consistency that will permit placing. Mortar shall be thoroughly compacted into the prepared void by tamping, rodding, ramming, etc. and struck off to match adjacent concrete. Replacement concrete shall be produced using project materials and shall be proportioned by the Contracting Officer. It shall be thoroughly compacted into the prepared void by internal vibration, tamping, rodding, ramming, etc. and shall be struck off and finished to match adjacent concrete. Forms shall be used to confine the concrete. If an expanding agent is used in the repair concrete, the repair shall be thoroughly confined on all sides including the top surface. Metal tools shall not be used to finish permanently exposed surfaces. The repaired areas shall be cured for 7 days. The temperature of the in situ concrete, adjacent air, and replacement mortar or concrete shall be above 5 degrees C during placement, finishing, and curing. Other methods and materials for repair may be used only when approved in writing by the Contracting Officer. Repairs of the so called "plaster-type" will not be permitted.

3.4 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE when tested as specified herein.

3.4.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE paragraphs Hot Weather Requirements

and Prevention of Plastic Shrinkage Cracking above shall be met.In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 1.0 kg/square meter per hour. Make provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.4.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.4.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. All roof slabs and floor slabs unless noted otherwise on the Drawings shall be given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. No water, cement, or mortar shall be added to the surface during the finishing operation. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Perform floating by use of suitable hand floats or power driven equipment. Use sufficient pressure on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating

water into the surface.

3.4.4 Troweled Finish

All exposed floor slabs shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

-- End of Section --

SECTION 03 39 00.00 10

CONCRETE CURING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete

1.2 SUBMITTALS

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

SD-06 Test Reports

Testing and Inspection for CQC; G

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be stored in such a manner as to avoid contamination and deterioration. Materials shall be capable of being accurately identified after bundles or containers are opened.

PART 2 PRODUCTS

2.1 CURING MATERIALS

2.1.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.1.2 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.2 WATER

Water for curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

PART 3 EXECUTION

3.1 FINISHING UNFORMED SURFACES

3.2 CURING AND PROTECTION

3.2.1 General

Concrete shall be cured by an approved method for the period of time given below:

Portland cement blended with silica fume	7 days
Type I portland cement	7 days

Immediately after placement, protect concrete from premature drying, extremes in temperatures, rapid temperature change and mechanical injury for the duration of the curing period. Concrete shall be protected from the damaging effects of rain for 12 hours and from flowing water for 14 days. No fire or excessive heat including welding shall be permitted near or in direct contact with concrete or concrete embedments at any time. Maintain air and forms in contact with concrete at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds in PART 2, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.2.2 Moist Curing

Maintain concrete, to be moist-cured, continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be carefully broken loose from the concrete, soon after the concrete hardens, and curing water continuously applied into the

void so as to continuously saturate the entire concrete surface. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Provide an approved work system to ensure that moist curing is continuous 24 hours per day. Horizontal construction joints may be allowed to dry for 12 hours immediately prior to the placing of the following lift. Silica fume concrete, if used, shall be moist-cured. Curing of silica fume concrete shall start immediately after placement.

3.2.3 Impervious Sheeting (Evaporative Retardant)

The following concrete surfaces may be cured using impervious sheets: exterior slab on grade. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Use impervious-sheet curing only on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 450 mm wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 300 mm and securely weighted down or shall be lapped not less than 100 mm and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.2.4 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.2.5 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C maintain the temperature of the concrete above 5 degrees C for the first seven days after placing. During the period of protection removal, control the air temperature adjacent to the concrete surfaces so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. Perform the installation of the thermometers as directed.

3.3 TESTING AND INSPECTION FOR CQC

Perform the inspection and tests described below and, based upon the results of these inspections and tests, take the action required. Submit certified copies of laboratory test reports, including curing compound proposed for use on this project.

3.3.1 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be

made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

-- End of Section --

SECTION 04 20 00

MASONRY

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 530/530.1	(2008; Errata 2008; Errata 2009) Building Code Requirements and Specification for Masonry Structures and Related 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 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	(2010a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 67	(2009) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
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 91	(2005) Masonry Cement
ASTM C 94/C 94M	(2010) Standard Specification for Ready-Mixed Concrete
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009; Errata First Printing) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

1.2.1.1 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.

1.2.1.2 Seismic Requirement

In addition to design requirements of ICC IBC, provide additional seismic reinforcement in accordance with UFC 3-310-04 as detailed on the drawings. The total minimum reinforcing percentage for structural walls shall be 0.20 percent. The vertical reinforcement ratio will be at least 0.05 percent, spaced no more than 1200 mm with reinforcement within 410 mm of the ends of walls. The horizontal reinforcement ratio must be at least 0.025 percent, consisting of either joint reinforcement spaced no more than 410 mm, or bond beam reinforcement spaced no more than 1200 mm, with reinforcement within 410 mm of the top and bottom of the wall.

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.

1.2.1.3 Special Inspection

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

1.2.1.4 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.

1.2.2 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 ICC IBC.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Concrete Masonry Units (CMU); G
Cement; G
Insulation; G
Flashing; G
Cold Weather Installation; G

SD-04 Samples

Concrete Masonry Units (CMU); G
Anchors, Ties, and Bar Positioners; G
Expansion-Joint Materials; GJoint Reinforcement; G

SD-05 Design Data

Pre-mixed Mortar; G
Unit Strength Method; G

SD-06 Test Reports

Efflorescence Test; G
Field Testing of Mortar; G
Field Testing of Grout; G
Prism tests; G
Masonry Cement; G
Masonry Inspector Qualifications; G

SD-07 Certificates

Concrete Masonry Units (CMU)
Control Joint Keys
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Reinforcing Steel Bars and Rods
Masonry Cement
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

SD-08 Manufacturer's Instructions

Masonry Cement

1.4 QUALITY ASSURANCE

1.4.1 Sample Masonry Panels

After material samples are approved and prior to starting masonry work, construct a masonry panel . At least 48 hours prior to constructing the sample panel or panels, submit written notification to the Contracting Officer. Submit one panel 600 by 600 mm. 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 2.5 m long by 1.2 m 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; 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, insulation, flashing, and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam

corner. Panels shall show parging and installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 600 by 600 mm opening placed at least 600 mm above the panel base and 600 mm 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 bring up the masonry wythes; 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. Submit copies of masonry inspector reports.

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 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66. Submit 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.

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

1.6 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 37 degrees C in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 32 degrees C and the wind velocity is more than 13 km/h. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m 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 4 degrees C or temperature of masonry units is below 4 degrees C, 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)

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

a. Hollow Non-Load-Bearing Units: ASTM C 90, made with normal weight aggregate. Provide load-bearing units for all walls.

2.2.1 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 25 mm. 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

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 28 MPa minimum conforming to Section 03 30 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 19 mm 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 827 kPa 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 35 kg 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 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 6 mm allowance for mortar joints. The ends of sills, except a 19 mm 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 16 mm

diameter bars.

2.3.2 Splash Blocks

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

2.4 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 all walls. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.4.1 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.

2.4.2 Hydrated Lime and Alternates

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

2.4.3 Cement

Portland cement shall conform to ASTM C 150/C 150M, Type I or V. Masonry cement shall conform to ASTM C 91, Type S. 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 10 percent silica fume. When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required. Additives shall conform to requirements in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

2.4.4 Pre-Mixed Mortar

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

2.4.5 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.

2.5 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. Minimum grout strength shall be 14 MPa 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.

2.5.1 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.

2.5.2 Grout Barriers

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

2.6 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 16 mm mortar cover from either face.

2.6.1 Wire Mesh Ties

Wire mesh for tying 100 mm thick concrete masonry unit partitions to other intersecting masonry partitions shall be 13 mm mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 300 mm.

2.6.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm wide. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm. The pintle and eye elements shall be formed so that both can be in the same plane.

2.6.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 5 mm diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03 30 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.6.4 Adjustable Anchors

Adjustable anchors shall be 5 mm diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm diameter steel bars placed to

provide 2 mm 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.

2.6.5 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.

2.7 JOINT REINFORCEMENT

Joint reinforcement shall be installed as indicated on the Drawings.. Reinforcement shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.8 REINFORCING STEEL BARS AND RODS

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

2.9 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 2 mm. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.10 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires. Submit certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

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. Submit one piece of each type of material used.

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: 0.2 kg, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 1.8 kg/square meter (approximately 0.9 kg/square meter on each side).

b. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 450 kg weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 4 mm 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.

c. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 0 degrees C, shall show no cracking when, at that temperature, it is bent 180 degrees over a 2 mm diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.

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 10 mm 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 4 to 0 degrees C. Sand or mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C

b. Air Temperature 0 to minus 4 degrees C. Sand and mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature minus 4 to minus 7 degrees C. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C. 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 24 km/hour.

d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C. Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C. Temperature of units when laid shall not be less than minus 7 degrees C.

3.1.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 4 to 0 degrees C. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 0 to minus 4 degrees C. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature minus 4 to minus 7 degrees C. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C 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 3 mm. 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. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm.

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. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and 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 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

d. In double wythe construction, the inner wythe may be brought up not more than 400 mm ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm.

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

Where vertical reinforcement occurs, fill 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 50 by 75 mm. 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 13 mm. 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 in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below

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	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variation from level for bed joints and top surfaces of bearing walls	
In 3 m	6 mm
In 12 m or more	13 mm
Variations from horizontal lines	
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

TOLERANCES

Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	6 mm
Plus	13 mm

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 300 mm 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 10 mm. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm.

3.2.7 Joint Widths

Joint widths shall be as follows:

3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints, except for prefaced concrete masonry units.

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 where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 100 mm nominal thick units shall be tied to intersecting partitions of 100 mm units, 125 mm into partitions of 150 mm units, and 175 into partitions of 200 mm or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 100 mm thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

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 6 mm in diameter at 600 mm o.c. Weep holes shall be provided not more than 600 mm 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. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for

providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.4 COMPOSITE WALLS

Masonry wythes shall be tied together with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03 30 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm on center vertically and 600 mm on center horizontally. Unit ties shall be spaced not over 600 mm on centers horizontally, in courses not over 400 mm apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.5 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.

3.6 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 50 mm of tops of walls.

3.6.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm 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.

3.6.2 Splices

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

3.7 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 400 mm on center or as indicated. Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.8 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams 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.

3.8.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.8.2 Horizontal Grout Barriers

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

3.8.3 Grout Holes and Cleanouts

3.8.3.1 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 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.8.3.2 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 1.5 m. 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 800 mm 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 75 by 100 mm 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.

3.8.4 Grouting Equipment

3.8.4.1 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.

3.8.4.2 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.

3.8.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. 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 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

3.8.5.1 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 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm 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.

3.8.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm 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 1.2 m 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 300 to 450 mm 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 (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

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 20 mm or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.9 BOND BEAMS

Cast-in-place concrete bond beams shall be sized and reinforced as indicated on the drawings. Reinforcement shall be continuous, including around corners, 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.

3.10 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm groove near the center at end of each unit. The vertical 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 19 mm; 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 6 mm. Concealed control joints shall be flush cut.

3.11 JOINTS SHOWN ON THE DRAWINGS

a. Brick expansion joints

b. Concrete masonry veneer joints

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

3.12 LINTELS

3.12.1 Cast-in-Place Concrete Lintels

Construct cast-in-place concrete lintels as indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater.

3.13 SILLS AND COPINGS

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

3.14 ANCHORAGE TO CONCRETE

3.14.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.15 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.16 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.17 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.

3.17.1 Dry-Brushing

a. Exposed concrete masonry unit

b. Exposed concrete brick surfaces

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

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 600 mm 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. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

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 13 to 16 mm 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 13.8 MPa at 28 days.

3.20.3 Efflorescence Test

Test brick, which will be exposed to weathering, for efflorescence. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.20.4 Prism Tests

Perform at least one prism test sample for each 465 square meters 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 11.7 MPa at 28 days. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa, 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 3.5 MPa 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 05 23

WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(2006) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying
AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008; Errata 2008) Structural Welding Code - Sheet Steel
AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel
AWS Z49.1	(2005) Safety in Welding, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E 165	(2002) Standard Test Method for Liquid Penetrant Examination
ASTM E 709	(2008) Standard Guide for Magnetic Particle Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear

understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.3.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model on the drawings. All welders qualified and designated to perform field-welded groove joints must be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints must be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.4 SUBMITTALS

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

SD-03 Product Data

Welding Procedure Qualifications; G
Welder, Welding Operator, and Tacker Qualification
Inspector Qualification
Previous Qualifications
Pre-qualified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control
Nondestructive Examination

A quality assurance plan and records of tests and inspections. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)
Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR)
Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

Certificates in accordance with paragraph "Other Applications".

1.5 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

The organization performing this work must be certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category Category I Conventional Steel Structures or approved equivalent.

a. For Structural Projects, provide documentation of the following:

1) Component Thickness 3 mm and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

2) Component Thickness Less than 3 mm: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

1) Submit for approval to the Contracting Officer two copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

2) Submit for approval to the Contracting Officer two copies of Certified Welder Performance Qualifications (WPQ) and Certified Brazer Performance Qualifications (BPQ) within fifteen calendar days prior to any employee welding on the project material.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification not withstanding the fact the code or specification may allow pre-qualified procedures.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.5.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.5.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification must state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.5.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.5.6 Inspector Qualification

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.5.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe weldiing practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 1 m intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual andradiographic inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection and radiographic methods. The minimum extent of nondestructive testing must be random 10 percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING

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 SG02-KIT	(2001; Supp 1 2004) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2008; Errata 2008) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2010) 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 A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A370	(2010) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 1513	(2010) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM C 955	(2010) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing

	or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E 329	(2010) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM F 1941M	(2007) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components; G

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

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

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-03 Product Data

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

SD-05 Design Data

Metal framing calculations; G

SD-07 Certificates

Load-bearing cold-formed metal framing

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

Welds

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M.

1.3 DELIVERY, STORAGE, AND HANDLING

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

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI SG03-3. Non-load-bearing metal framing, furring, and ceiling suspension systems are specified in Section 09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD. Metal suspension systems for acoustical ceilings are specified in Section 09 51 00 ACOUSTICAL CEILINGS.

1.5 MAXIMUM DEFLECTION

a. Floor Joists:

L/360 - Live load only
L/240 - Total load

b. Roof Rafters:

L/240 - Live load only

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

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

1.6.2 Design Data Required

Submit metal framing calculations to verify sizes, gages, and spacing of members and connections. Show methods and practices used in installation.

PART 2 PRODUCTS

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

Framing components shall comply with ASTM C 955 and the following.

2.1.1 Studs and Joists of 1.5 mm and Heavier

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

2.1.2 Studs and Joists of 1.2 mm and Lighter

Studs and Joists of 1.2 mm and Lighter, Track, and Accessories (All Gages): Galvanized steel, ASTM A653/A653M, SS, Grade 345 230 MPa Z180; or carbon steel, ASTM A1008/A1008M, Grade C, painted.

2.1.3 Sizes, Gages, Section Modulus, and Other Structural Properties

Size and gage as indicated. Steel stud deflection shall be limited to L/600 for exterior wall brick veneer construction.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 1200 mm on center and shall be legible and easily read. The product marking shall include the following:

a. An ICC number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling, tapping screws in compliance with ASTM C 1513 of the type, size and location as shown on the drawings. Electroplated screws shall have a minimum 5 micron zinc coating in accordance withASTM F 1941M. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate.

2.4 PLASTIC GROMMETS

Supply plastic grommets, recommended by stud manufacturer, to protect electrical wires. Prevent metal to metal contact for plumbing pipes.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling or self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI SG02-KIT. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 1.2 mm.

3.1.2 Screws

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

3.1.3 Anchors

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

3.2 INSTALLATION

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 75 mm from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 600 mm wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI SG03-3, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 3000 mm	One row at mid-height
	Over 3000 mm	Rows 1500 mm o.c. maximum
Axial load	Up to 3000 mm	Two rows at 1/3 points
	Over 3000 mm	Rows 900 mm o.c. maximum

3.2.3 Joists and Trusses

Locate each joist or truss directly above a stud. Provide doubled joists under parallel partitions wherever partition length exceeds 1/2 of joist span. Joists shall have at least 60 mm of bearing on steel, 100 mm on masonry, and shall be reinforced over bearings where required to prevent web crippling. Splice joists over bearings only. Lap and weld splices as

indicated. Provide manufacturer's standard bridging which shall not be less than the following:

CLEAR SPAN	BRIDGING
Up to 4200 mm	One row near center
4200 mm to 6000 mm	Two rows at 1/3 points
6000 mm to 7800 mm	Three rows at 1/4 points
7800 mm to 10600 mm	Four rows at 1/5 points

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

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 6 mm from intended position;

(2) Plates and runners: 6 mm in 2400 mm from a straight line;

(3) Studs: 6 mm in 2400 mm out of plumb, not cumulative; and

(4) Face of framing members: 6 mm in 2400 mm from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 6 mm from intended position;

(2) Plates and runners: 3 mm in 2400 mm from a straight line;

(3) Studs: 3 mm in 2400 mm out of plumb, not cumulative; and

(4) Face of framing members: 3 mm in 2400 mm from a true plane.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

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 2010; Errata 2010) Building Code Requirements for Structural Concrete and Commentary

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

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

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2010) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Standard for Square and Hex Nuts
ASME B18.21.2M	(1999; R 2005) Lock Washers (Metric Series)
ASME B18.22M	(1981; R 2010) Metric Plain Washers
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	(2005; R 2009) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 108/B 108M	(2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 26/B 26M	(2009) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C 1513	(2010) Standard Specification for Steel Tapping Screws for Cold-Formed Steel

Framing Connections

ASTM D 1187 (1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 532 (2009) Heavy Duty Metal Bar Grating Manual

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

1.2 SUBMITTALS

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

SD-02 Shop Drawings

HVAC Equipment Frames; G

Access doors and panels, installation drawings; G

Roof hatch; G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Access doors and panels

Roof hatch

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove

and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

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

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Gratings

a. Gray cast iron ASTM A48/A48M, Class 40.

b. Metal plank grating, non-slip requirement, aluminum ASTM B 209M , 6061-T6; steel ASTM A653/A653M, Z275.

c. Metal bar type grating NAAMM MBG 532.

2.1.6 Floor Plates, Patterned

Floor plate ASTM A786/A786M. Steel plate shall not be less than 1.9 mm.

2.1.7 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.7.1 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.2 Toggle Bolts

ASME B18.2.1.

2.1.7.3 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.7.4 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C 1513.

2.1.7.5 Washers

Provide plain washers to conform toASME B18.22M. Provide beveled washers

for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.2M.

2.1.8 Aluminum Alloy Products

Conform to ASTM B 209M for sheet plate, ASTM B 221M for extrusions and ASTM B 26/B 26M or ASTM B 108/B 108M for castings, as applicable. Provide aluminum extrusions at least 3 mm thick and aluminum plate or sheet at least 1.3 mm thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 1.9 mm with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 350 by 500 mm and of not lighter than 1.9 mm steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surfaces with a shop applied prime coat.

2.4 HVAC EQUIPMENT FRAMES

Provide steel framed, open grate platforms including ladders and guardrails to support each exterior air handling unit at the SOF JOC and Command and Control Buildings (total of 2 platforms). Each platform shall be sized for each specific air handling unit including grated steel access walkways as necessary to allow reasonable access to the unit for maintenance. Platforms shall be 1 meter high. Frames shall be fabricated of standard steel shapes, floor grating, guardrails and ladders shall be in accordance with Section 05 51 00 METAL STAIRS, 05 51 33 METAL LADDERS AND 05 52 00 METAL RAILINGS. Frames shall be designed to support air handling unit dead load plus 25% as well as resist all applied lateral forces including seismic forces. Frames shall be anchored to concrete footings.

Seismic Performance: The design of the frame shall be capable of withstanding the effects of earthquake motions of seismic spectral acceleration based on Ss = 0.30g, 2.0 sec period spectral acceleration and S1 = 0.16g, 1.0 sec period spectral acceleration, Importance Factor I = 1.50.

The frame structures shall be founded on individual footings. Contractor shall coordinate the geotechnical subsurface for the soil design parameters to be used in the foundation design. All footings shall be placed on natural undisturbed subgrade or compacted select granular fill, as per Section 31 00 00 EARTHWORK. All footings shall have a minimum depth of 800mm for frost protection. The foundations concrete shall be in accordance with Section 03 31 00.00 10 CAST-IN_PLACE STRUCTURAL CONCRETE. Structural design of the foundations shall be in accordance with ACI 318.

2.5 GENERATOR SUNSHADES AND DIESEL FUEL TANK SUNSHADES

Provide sunshade(s) open on all sides with a minimum clear interim height of 3m and a minimum roof slope of 1:12. Coordinate final size of sunshade(s) based on the equipment provided, final layout and the following conditions:

a. Extend edges of sunshade(s) 1 meter beyond furthest edge of any piece of equipment in all directions.

b. Provide a minimum of 1 meter clearance above the top of any piece of equipment.

c. Coordinate locations of structural bracing so as not to limit access for maintenance or interfere with minimum clearance.

d. Live loads: Roof live loads shall be 98 kg/m2 as per ASCE 7-05, as well as loads induced by maintenance workers, materials and equipment.

e. Roof Snow load: Include vertical loads induced by weight of snow. Snow load shall be 98 kg/m2. Allow for unbalanced and drift loads.

f. Wind load: Wind load shall be calculated as per ASCE/SEI 7-05, using a "3-second gust" wind speed of 145 km/hr, Exposure C, Importance Factor=1.0.

g. Collateral loads: Include additional dead load other than weight of sunshade for permanent items such as electrical systems, mechanical systems, etc.

h. Seismic performance: The design of the building system shall be capable of withstanding the effects of earthquake motions of seismic spectral acceleration based on Ss=0.30g and S1=0.16g, Occupancy Category II, Site Class D and Importance Factor I=1.0.

Load combination and deflection criteria shall be as per International Building Code 2009.

The sunshade structures shall be founded on individual footings. Contractor shall coordinate the geotechnical subsurface for the soil design parameters to be used in the foundation design. All footings shall be placed on natural undisturbed subgrade or compacted select granular fill, as per Section 31 00 00 EARTHWORK. All footings shall have a minimum depth of 800mm for frost protection. The foundations concrete shall be in accordance with Section 03 31 00.00 10 CAST-IN_PLACE STRUCTURAL CONCRETE. Structural design of the foundations shall be in accordance with ACI 318.

2.5.1 Metal Roof Panels

Roll formed roof panels with FY = 30ksi, .26 gauge, profile similar to "Butlerib II" by Butler Manufacturing Company. Panels to receive factory applied finish to both sides with color as selected by Contracting Officer. Roof panels shall run continuously from eave to eave lapped and sealed per the manufacturer's recommendations to provide a complete water tight system. Provide closures and drip edgtes to form a neat finished appearance.

2.6 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners or welds. Construct to have at least 200 mm bearing on masonry at each end.

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

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with

the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

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

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

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

3.4 BUILT-IN WORK

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

3.5 WELDING

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

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a

remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer.

3.7 ACCESS PANELS

Install a removable access panel not less than 300 by 300 mm directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.9 ROOF HATCH (SCUTTLES)

Provide zinc-coated steel sheets not less than 1.9 mm, with 75 mm beaded flange, welded and ground at corner. Provide a minimum clear opening of 760 by 900 mm. Construction and accessories as follows:

a. Insulate cover and curb with 25 mm thick rigid fiberboard insulation covered and protected by zinc-coated steel liner not less than 0.45 mm with 300 mm high curb, formed with 75 mm mounting flange with holes provided for securing to the roof deck. Equip the curb with an integral metal cap flashing of the same gage and metal as the curb, full welded and ground at corners for weather tightness.

b. Provide hatch completely assembled with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside, and neoprene draft seal. Provide fasteners for padlocking on the inside. Equip the cover with an automatic hold-open arm complete with grip handle to permit one-hand release. Cover action shall be smooth through its entire range with an operating pressure of approximately 130 N.

3.10 RECESSED FLOOR FRAMES & MATS

Verify field measurements prior to releasing materials for fabrication by the manufacturer. Use a mat frame to ensure recess accuracy in size, shape and depth. Assemble frames onsite and install so that upper edge will be level with finished floor surface. Anchor into the cement with anchor pins a minimum of 610 mm on centers.

-- End of Section --

SECTION 05 51 00

METAL STAIRS

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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 360	(2005) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

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

ASME INTERNATIONAL (ASME)

ASME B18.2.3.8M	(1981; R 2005) Metric Hex Lag Screws
ASME B18.22M	(1981; R 2010) Metric Plain Washers
ASME B18.6.7M	(1999; R 2010) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2010) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A1011/A1011M	(2010) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A108	(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc

	Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2003; R 2007) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A29/A29M	(2005) Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought General Requirements for
ASTM A325M	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A449	(2010) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A512	(2006) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A568/A568M	(2009a) Standard Specifications for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A575	(1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A6/A6M	(2010a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
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
ASTM F 1679	(2004e1) Standard Test Method for Using a Variable Incidence Tribometer
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2009) Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2009; TIA 09-1; TIA 09-2) Life Safety Code

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Submit fabrication drawings for the following items in accordance with the paragraph entitled, "General Requirements," of this section.

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

Metal Stair System

SD-03 Product Data

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

Structural Steel Plates, Shapes, and Bars

Structural Steel Tubing

Hot-Rolled Carbon Steel Sheets and Strips

Cold Finished Steel Bars

Hot-Rolled Carbon Steel Bars

Cold-Rolled Carbon Steel Sheets

Galvanized Carbon Steel Sheets

Cold-Drawn Steel Tubing

Gray Iron Castings

Malleable Iron Castings

Masonry Anchorage Devices

Protective Coating

Steel Stairs

SD-08 Manufacturer's Instructions

Submit manufacturer's installation instructions for the following products used in the fabrication of steel stair work.

Structural Steel Plates, Shapes, and Bars

Structural Steel Tubing

Hot-Rolled Carbon Steel Sheets and Strips

Cold Finished Steel Bars

Hot-Rolled Carbon Steel Bars

Cold-Rolled Carbon Steel Sheets

Galvanized Carbon Steel Sheets

Cold-Drawn Steel Tubing

Gray Iron Castings

Malleable Iron Castings

Protective Coating

Masonry Anchorage Devices

1.3 QUALIFICATIONS FOR WELDING WORK

Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Submit complete and detailed fabrication 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.

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 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Structural-size shapes and plates, conforming to ASTM A36/A36M, unless otherwise noted, except bent or cold-formed plates.

Steel plates - bent or cold-formed, conforming to ASTM A283/A283M, Grade C.

Steel bars and bar-size shapes, conforming to ASTM A36/A36M, unless otherwise noted for steel bars and bar-size shapes.

2.3 STRUCTURAL STEEL TUBING

Structural steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

2.4 HOT-ROLLED CARBON STEEL BARS

Hot-rolled carbon steel bars and bar-size shapes, conforming to ASTM A575, grade as selected by the fabricator.

2.5 COLD-FINISHED STEEL BARS

Cold-finished steel bars conforming to ASTM A108, grade as selected by the fabricator.

2.6 HOT-ROLLED CARBON STEEL SHEETS AND STRIPS

Hot-rolled carbon sheets and strips conforming to ASTM A568/A568M and ASTM A1011/A1011M, pickled and oiled.

2.7 COLD-ROLLED CARBON STEEL SHEETS

Cold-rolled carbon steel sheets conforming to ASTM A1008/A1008M.

2.8 GALVANIZED CARBON STEEL SHEETS

Galvanized carbon steel sheets conforming to ASTM A653/A653M, with galvanizing conforming to ASTM A653/A653M and ASTM A924/A924M.

2.9 COLD-DRAWN STEEL TUBING

Cold drawn steel tubing conforming to ASTM A512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.10 GRAY IRON CASTINGS

Gray iron castings conforming to ASTM A48/A48M, Class 30.

2.11 MALLEABLE IRON CASTINGS

Malleable iron castings conforming to ASTM A47/A47M, grade as selected.

2.12 STEEL PIPE

Steel pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.13 MASONRY ANCHORAGE DEVICES

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

a. Lead expansion shields for machine screws and bolts 6 millimeter and smaller; head-out embedded nut type, single unit class, Group I, Type 1, Class 1.

b. Lead expansion shields for machine screws and bolts larger than 6 millimeter in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 2.

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

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

Toggle bolts of the tumble-wing type, conforming to ASTM A325M, ASTM A449 and ASTM C 636/C 636M, type, class, and style as required.

2.14 FASTENERS

Galvanized zinc-coated fasteners in accordance with ASTM A153/A153M and 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.

Standard/regular hexagon-head bolts and nuts be conforming to ASTM F 568M,.

Square-head lag bolts conforming to ASME B18.2.3.8M,.

Machine screws cadmium-plated steel conforming to ASME B18.6.7M,.

Plain washers, round, general-assembly-grade, carbon steel conforming to ASME B18.22M.

Lockwashers helical spring, carbon steel conforming to ASME B18.2.3.8M.

2.15 GENERAL FABRICATION

Prepare and submit metal stair system shop drawings with detailed plans and elevations at not less than 1 to 12 scale with details of sections and connections at not less than 1 to 4 scale. Also detail placement drawings, diagrams, templates for installation of anchorage, including but not limited to, concrete inserts, anchor bolts, and miscellaneous metal items having integral anchorage devices.

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

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 0.8 millimeter, and bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

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

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

Provide and coordinate anchorage of the type indicated with the supporting structure. Fabricate anchoring devices, space as indicated and 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 as fabricated from cold-finished or cold-rolled stock.

2.16 PROTECTIVE COATING

Hot dip galvanize steelwork on exterior stairs as indicated in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.17 STEEL STAIRS

2.17.1 General

Use welding for joining pieces together. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and connections between parts lightproof tight. Grid smooth continuous welds where exposed.

Construct metal stair units to sizes and arrangements indicated to support a minimum live load of 500 kilogram per square meter. Provide framing, hangers, columns, struts, clips, brackets, bearing plates, and other components as required for the support of stairs and platforms.

2.17.2 Stair Framing

Fabricate stringers of structural steel channels, or plates, or a combination thereof as indicated. Provide closures for exposed ends of strings.

Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt headers to stringers and newels and framing members to stringers and headers.

2.17.3 Floor Grating Treads And Platforms

Provide floor grating treads and platforms conforming to ASTM A6/A6M, ASTM A29/A29M and NAAMM MBG 531, "Metal Bar Grating Manual." Provide steel pressure locked landing and tread grating with serrated surface, 30 mm x 100 mm spacing.

a. Galvanized finish conforming to ASTM A123/A123M.

Fabricate grating treads with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for string connections. Secure treads to strings with bolts.

Fabricate grating platforms with nosing that matches on grating treads at landings. Provide toe-plates at open-sided edges of floor grating to platform framing members.

2.17.4 Safety Treads

ASTM A1011/A1011M, steel pan for concrete tread.

2.17.5 Steel Stairs

Provide steel stairs complete with stringers, metal-pan concrete-filled treads, grating treads, landings, columns, handrails, and necessary bolts and other fastenings. Hot-dip galvanize and/or shop paint steel stairs and accessories.

2.17.5.1 Design Loads

Design stairs to sustain a live load of not less than 490 kg per square meter, or a concentrated load of 140 kg applied where it is most critical. Conform to ANSI/AISC 360 with the design and fabrication of steel stairs, other than a commercial product. Design fire stairs to conform to NFPA 101.

2.17.5.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Screw or screw-type connections are not permitted.

a. Structural Steel: ASTM A36/A36M.

b. Gratings for Treads and Landings: NAAMM MBG 531 or Plank grating; ASTM A653/A653M, Z275 for steel. Provide gratings with nonslip nosings with slip resistance exceeding a static coefficient of friction, both wet and dry, of 0.5 as tested in accordance with ASTM F 1679.

c. Support metal pan for concrete fill and steel grating on angle cleats

welded to stringers or treads with integral cleats, welded or bolted to the stringer. Provide sheet-steel landings with angle stiffeners welded on. Close exposed ends. For exterior stairs, form all exposed joints to exclude water.

d. Before fabrication, obtain necessary field measurements and verify drawing dimensions.

e. Clean metal surfaces free from mill scale, flake rust and rust pitting prior to shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

PART 3 EXECUTION

3.1 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.2 INSTALLATION OF SAFETY NOSINGS

Completely embed nosing in concrete before the initial set of the concrete occurs and finish flush with the top of the concrete surface.

3.3 FIELD WELDING

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

3.4 TOUCHUP PAINTING

Immediately after installation, clean all field welds, bolted connections, and abraded areas of the shop painted material, and repaint exposed areas with the same paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 0.051 millimeter.

-- End of Section --

SECTION 05 51 33

METAL LADDERS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

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

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

29 CFR 1910.27	Fixed Ladders

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, installation drawings

SD-03 Product Data

Ladders

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

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

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.2 FABRICATION FINISHES

2.2.1 Shop Cleaning and Painting

2.2.1.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.1.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a

minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.

2.3 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 65 by 10 mm steel flats for stringers and 20 mm diameter steel rods for rungs. Rungs to be not less than 400 mm wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 175 mm. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 12 mm diameter expansion bolts as indicated. Provide intermediate clip angles not over 1200 mm on centers.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, and expansion anchors when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

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

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.5.2 Field Preparation

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

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer.

3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 12 mm diameter expansion bolts. Install intermediate clip angles not over1200 mm on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon finished roof.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS

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 IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2004) Standard Definitions for Use in the Design of Steel Structures

AMERICAN WELDING SOCIETY (AWS)

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

ASME INTERNATIONAL (ASME)

ASME B18.2.3.8M	(1981; R 2005) Metric Hex Lag Screws
ASME B18.22M	(1981; R 2010) Metric Plain Washers
ASME B18.6.7M	(1999; R 2010) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2010) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A283M	(2003; R 2007) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A325M	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	(2008) Standard Specification for Carbon

	Structural Steel
ASTM A449	(2010) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
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
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

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

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Iron and Steel Hardware; G

Steel Shapes, Plates, Bars and Strips

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; G

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Steel Railings and Handrails; G

SD-08 Manufacturer's Instructions

Installation Instructions; G

1.3 QUALITY ASSURANCE

1.3.1 Welding Procedures

Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

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 to 12 scale. Provide details of sections and connections at not less than 1 to 4 scale. 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 0.8 millimeter. 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 STRUCTURAL STEEL PLATES, SHAPES AND BARS

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.

Provide steel plates, to be bent or cold-formed,conforming to ASTM A283/A283M, Grade C.

Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

2.4 STEEL PIPE

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.5 CONCRETE INSERTS (ANY OF THE FOLLOWING)

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive M20 diameter machine bolts; either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, hot-dip galvanized in accordance with ASTM A153/A153M.

Provide wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept M20 diameter bolts having special wedge-shaped heads, made of either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M and hot-dip galvanized in accordance with ASTM A153/A153M.

Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A153/A153M. Provide slotted-type concrete inserts consisting of galvanized 3 millimeter thick pressed steel plate conforming to ASTM A283/A283M, made of box-type welded construction with slot designed to receive M20 diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with ASTM A123/A123M.

2.6 MASONRY ANCHORAGE DEVICES

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

Provide lead expansion shields for machine screws and bolts 6

millimeter and smaller; head-out embedded nut type, single unit class, Group I, Type 1, Class 1.

Provide lead expansion shields for machine screws and bolts larger than 6 millimeter in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 2.

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 A325M, ASTM A449 and ASTM C 636/C 636M, type, class, and style as required.

2.7 FASTENERS

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M 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 F 568M.

Provide square-head lag bolts conforming to ASME B18.2.3.8M.

Provide cadmium-plated steel machine screws conforming to ASME B18.6.7M.

Provide plain round, general-assembly-grade, carbon steel washers conforming to ASME B18.22M.

Provide helical spring, carbon steel lockwashers conforming to ASME B18.2.3.8M.

2.8 PROTECTIVE COATING

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

Shop prime interior steelwork as indicated in accordance with AISC/AISI 121 except surfaces of steel to be encased in concrete, surfaces to be welded, contact surfaces to be high-strength bolt connected.

Provide hot dipped galvanized steelwork as indicated on exterior stairs in accordance with ASTM A123/A123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.9 STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 490 N in any direction at any point of the top of the rail or 290 N/m 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.

2.9.1 Steel Handrails

Provide steel handrails, including inserts in concrete. Provide steel

railings of 40 mm nominal size, hot-dip galvanized and shop painted.

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 10 mm 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 150 mm 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.

Galvanize exterior railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

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

a. Structural steel plates, shapes, and bars

b. Protective coating

c. Masonry anchorage devices

d. Steel railings and handrails

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 1800 millimeter on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard weight, steel pipe, not less than 150 millimeter long, and having an inside diameter not less than 13 millimeter greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 25 millimeter greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between post and sleeve with molten lead, sulfur, or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the

post.

Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

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

Anchor rail ends to steel with steel oval or round flanges welded to tail ends and bolted to the structural steel members.

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 75 millimeter projection from the finish wall surface to the center of the pipe drilled to receive one M10 bolt. Locate brackets not more than 1525 millimeter 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 concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

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

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.3 STEEL HANDRAIL

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement with anchorage covered with standard pipe collar pinned to post by means of base plates bolted to stringers or structural steel frame work. 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 0.051 millimeter.

-- End of Section --

SECTION 07 11 14

BITUMINOUS FLUID-APPLIED VAPOR BARRIER

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 412	(2006ae2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM E 2178	(2003) Standard Test Method for Air Permeance of Building Material
ASTM E 96/E 96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

1.2 SUBMITTALS

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

SD-03 Product Data

Asphalt Emulsion; G

SD-07 Certificates

Materials

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life.

PART 2 PRODUCTS

2.1 POLYMER-MODIFIED ASPHALT EMULSION

Continuous liquid-applied air barrier with an air permeance of no more than 0.02 liters per second per ASTM E 2178; a minimum water vapor permeance of not more than 0.1 perm per ASTM E 96/E 96M (method B) and a tensile elongation of not less than 50% per ASTM D 412

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Remove or cut ties and repair all surface defects as required by Section 03 31 00 CAST IN PLACE STRUCTURAL CONCRETE. Fill all voids and cracks in accordance with manufacturer's requirements. Clean concrete and masonry surfaces to receive vapor barrier of foreign matter and loose particles. Concrete shall be cured for a minimum of 7 days prior to vapor barrier application. Apply vapor barrier only to clean, dry surfaces.

3.2 PROTECTION OF SURROUNDING AREAS

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of dampproofing material onto other work.

3.3 APPLICATION

3.3.1 Preparation

Allow materials used during surface preparation to cure fully before application.

3.3.2 Spray Application

Apply to masonry and concrete surfaces in accordance with manufacturer's recommendations to a cured thickness of 40 mm. Use manufacturer's standard emulsifier.

3.3.3 Roller Application

Apply to masonry and concrete surfaces in accordance with manufacturer's recommendations to a cured membrane thickness of 40 mm.

-- End of Section --

SECTION 07 21 13

BOARD AND BLOCK INSULATION

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 203	(2005a) Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C 272	(2001; R 2007) Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 553	(2008) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(2010a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 1621	(2010) Compressive Properties of Rigid Cellular Plastics
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E 84	(2010b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Block or board insulation; G

Pressure sensitive tape

Accessories

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board or block thermal insulation conforming to the following standards and the physical properties listed below:

a. Extruded Preformed Cellular Polystyrene: ASTM C 578

2.1.1 Thermal Resistance

As indicated.

2.1.2 Fire Protection Requirement

a. Flame spread index of 75 or less when tested in accordance with ASTM E 84.

b. Smoke developed index of 200 or less when tested in accordance with ASTM E 84.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 170 kilopascals (kPa) when measured according to ASTM D 1621.

b. Flexural strength: Not less than 275 kPa when measured according to ASTM C 203.

c. Water Vapor Permeance: Not more than 6.3 by 10-8 g/Pa.s.m2 or less when measured according to ASTM E 96/E 96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

d. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C 272.

e. Water Adsorption: Not more than 1 percent by volume when measured in accordance with paragraph 14 of ASTM C 553.

2.1.4 Prohibited Materials

Do not provide materials containing asbestos.

2.2 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of 5.72 by 10-8 g/Pa.s.m2 or less when tested in accordance with ASTM D 3833/D 3833M.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by insulation manufacturer.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 INSTALLATION

3.2.1 Insulation Board

Install and handle insulation in accordance with the manufacturer's installation instructions. Keep material dry and free of extraneous

materials. Observe safe work practices.

3.2.2 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.3 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.3 INSTALLATION ON WALLS

3.3.1 Installation using Furring Strips

Install insulation between members as recommended by insulation manufacturer.

3.3.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant.

3.3.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

a. As recommended by the insulation manufacturer.

b. Use only full back method for pieces of 0.1 square meter or less.

c. Butt all edges of insulation and seal edges with tape.

3.4 INSTALLATION ON UNDERSIDE OF CONCRETE BEAMS

3.4.1 Adhesively Bonded Systems

Apply adhesive to underside of the and completely cover wall with insulation.

a. Full back bed method or

b. As recommended by insulation manufacturer.

c. Butt all edges of insulation and seal with tape.

3.5 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade or floating-slab construction.

3.5.1 Manufacturer's Instructions

Install, attach, tape edges, provide vapor retarder and other requirements such as protection against vermin, insects, damage during construction as recommended in manufacturer's instructions.

3.5.2 Insulation Under Slab

Provide insulation horizontally under slab on grade for a distance of 600 mm from the edge of slab as indicated. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

-- End of Section --

SECTION 07 22 00

ROOF AND DECK INSULATION

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 578	(2010a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM E 84	(2010b) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2011) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Taper cants and crickets

SD-03 Product Data

Fasteners

Insulation; G

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

Roof insulation, including field of roof and perimeter attachment requirements.

1.3 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

1.4 QUALITY ASSURANCE

1.4.1 Insulation over Built-Up Roofing System

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM APP GUIDE. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

Provide manufacturer's letter confirming that insulation will not melt or otherwise degrade when placed in direct contact with roofing system.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials

are covered by a referenced specification; and

Deliver materials in sufficient quantity to allow continuity of the work.

1.5.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 10 degrees C above grade and having ventilation around all sides. Replace damaged material with new material.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 4 degrees C and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

a. Polystyrene Board: Shall be in accordance with ASTM C 578, Type II, IV, or X.

2.1.2 Insulation Thickness

Insulation thickness shall be as indicated on drawings.

2.1.3 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 100 mm. Taper edge strips at a rate of 85 to 125 mm per meter down to approximately 3 mm thick.

2.2 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 35 mm diameter or hexagonal not less than 0.4 mm. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 75 mm in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 178 N each in steel deck. Fasteners for steel or

concrete decks shall conform to FM APP GUIDE for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 4.3 kPa.

2.2.1 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least 25 mm but not more than 38 mm, conforming to FM 4470, and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 4.31 kPa conforming to FM APP GUIDE.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall inspect and approve the surfaces immediately before starting installation.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots.

3.2 INSULATION INSTALLATION

Apply insulation in a minimum of two layers with staggered joints when total required thickness of insulation exceeds 13 mm. Lay insulation so that continuous longitudinal joints are perpendicular to direction of felts for the built-up roofing, as specified in Section 07 22 00 ROOF AND DECK INSULATION, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 13 mm clear of vertical surfaces penetrating and projecting from roof surface.

3.2.1 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in a heavy coating of asphalt roof cement.

3.2.2 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in heavy coating of asphalt roof cement.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing specified in Section 07 51 13 BUILT-UP ASPHALT ROOFING on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement or EPDM membrane set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

SECTION 07 51 13

BUILT-UP ASPHALT ROOFING

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1	(2004) Performance Standard for Retrofit Drains

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	(2010) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D 1863	(2005) Mineral Aggregate Used on Built-Up Roofs
ASTM D 2178	(2004) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 312	(2000; R 2006) Standard Specification for Asphalt Used in Roofing
ASTM D 3617	(2007) Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 4402	(2006) Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D 4897/D 4897M	(2001; R 2009) Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D 6163	(2000; R 2008) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM D2170/D2170M	(2010) Kinematic Viscosity of Asphalts (Bitumens)
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM E 108	(2010a) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	(2001; 5th Ed) Roofing and Waterproofing Manual

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Reprint Oct 2008) Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2011) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEMS

Asphalt applied, four-ply felt, built-up roof membrane system.

1.3 SUBMITTALS

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

SD-03 Product Data

wind uplift calculations

Asphalt

Felts, including ply felt, base sheet and ventilating felt as applicable; G

FLASHING MEMBRANE; G

Fasteners

Primer

Asphalt Roof Cement

Sample warranties certificates; G

Submit all data required with requirements of this section. Include in Data written acceptance by the roof membrane manufacturer of the products and accessories provided. List

products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-06 Test Reports

Samples of Built-Up Roofing

Submit test results on roofing field samples as required, verifying composition of sample. Submit six copies of laboratory analysis within 30 calendar days after samples are taken. Submit reports in accordance with ASTM D 3617.

SD-07 Certificates

bill of lading

Submit when labels of asphalt containers do not indicate the finished blowing temperature, flash point and equiviscous temperature.

Qualifications of Applicator

Submit evidence of the roofing system manufacturer's approval.

SD-08 Manufacturer's Instructions

felts; G

flashings; G

Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

Asphalt

Primer

roof cement

Fasteners

cold weather conditions installation; G

Include 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-11 Closeout Submittals

WARRANTY

INFORMATION CARD

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Applicator

The roofing system applicator must be approved, authorized, or licensed in writing by the roofing system manufacturer and must have a minimum of 3 years experience as an approved, authorized, or licensed applicator with the manufacturer and be approved at a level capable of providing the specified warranty.

1.4.2 Fire Resistance

Complete roof covering assembly must:

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 UL RMSD, or Class I roof deck construction in FM APP GUIDE.

1.4.3 Wind Uplift Resistance

Rate complete roof covering assembly, including insulation, as Class 1 A with a wind uplift pressure rating of 5.75 kpa per square meter in accordance with FM APP GUIDE. Do not install non-rated systems except as approved by the Contracting Officer. Submit licensed engineer's wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of90 km/hin accordance with ASCE 7-10
and/or other applicable building code requirements.

1.4.4 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 and 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 representatives to roof manufacturer;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work,

and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container must bear specification number, type, and class, as applicable. Indicate on labels or bill of lading for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (EVT), that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D2170/D2170M or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption, contamination, or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Maintain roll materials at temperature above 10 degrees C for a 24-hour period immediately prior to application. Keep aggregate dry as defined by ASTM D 1863. Place only those materials to be used during one day's work on the roof at one time. Remove unused materials from the roof at the end of each day's work. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 4 degrees C, or when there is ice, frost, moisture or visible dampness on roof deck. Restriction on application of roofing materials below 4 degrees C may be waived if Contractor devises a means, satisfactory to Contracting Officer, of: (1) maintaining surrounding temperature above 4 degrees C; (2) maintaining application temperature of heated materials without exceeding maximum specified heating temperature; and follows other recommendations of the membrane manufacturer for application in 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.

1.8 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty to comply with the specified requirements.

1.8.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Write the warranty directly to the Government commencing at the time of Government's acceptance of the roof work. Provide the following statement for such warranty:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. The warranty must remain in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.8.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.8.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA 0405, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 GENERAL

Furnish a combination of specified materials that comprise the membrane manufacturer's standard system of the number and type of plies specified. Materials provided must be approved by the roof membrane manufacturer and suitable for the service and climatic conditions of the installation.

2.2 FIBERGLASS FELT MATERIALS

a. Venting Base Sheet: ASTM D 4897/D 4897M, Type II, with perforations and as approved by the roof membrane manufacturer.

b. Ply Felt: ASTM D 2178, Type IV or VI.

2.3 BASE FLASHING MEMBRANE

ASTM D 6163. Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the built-up roof membrane and as recommended in membrane manufacturer's published literature. Provide a minimum base ply of flashing membrane of 1.8 mm thick. Provide a minimum granule surface modified bitumen flashing cap sheet of 3 mm thick on the selvage edge.

2.4 ASPHALT

ASTM D 312, Type II or III or IV, in accordance with membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.5 PRIMER

ASTM D41/D41M for asphalt roofing systems and as approved by the membrane manufacturer.

2.6 ASPHALT ROOF CEMENT

ASTM D 4586 for use with asphalt roofing systems, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces and as recommended by the membrane manufacturer.

2.7 FASTENERS AND PLATES

2.7.1 Masonry or Concrete Walls and Vertical Surfaces

Provide hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 25 mm long for securing felts, metal items, and accessories. Use power-driven fasteners

only when approved in writing by Contracting Officer.

2.7.2 Metal Plates

Flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; minimum 50 mm in diameter. Form discs to prevent dishing or cupping.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

a. Cants, control joints, expansion joints, perimeter walls, and roof penetrating components are in place.

b. Surfaces are rigid, clean, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. Inspect surfaces and approve immediately before application of roofing and flashings. Apply the roofing and flashings to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.

c. The plane of the substrate does not vary more than 6 mm within an area 3 by 3 meters when checked with a 3 meter straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing and will permit mechanical fastening of the base flashing materials.

f. Concrete substrates have been allowed to cure and the surface dryness requirements specified under paragraph entitled "Field Quality Control" have been met.

3.2 PREPARATION

Verify that work of other trades that penetrates the roof deck or requires men and equipment to traverse the roof deck is complete.

Examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution and quality of application.

Proceed with the roofing application only after defects have been corrected.

Starting work designates acceptance of the surfaces by the Contractor.

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists and kettles prior to starting the work. Lap protective coverings not less than six inch, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for

the duration of the roofing work.

3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane. Form felt bitumen stops with two 300 mm wide strips of organic ply felt. Laminate with and set strips into a coating of asphalt roof cement with one-half of the width overhanging the edge of the roof or opening. Where nailers are provided, nail the strips with roofing nails spaced 300 mm on center in addition to embedding in asphalt roof cement. Protect the free portion of each strip from damage throughout the roofing period. After the plies of felt are in place, fold free portion of the strips back over the roofing membrane and embed in a continuous coating of asphalt roof cement. Secure with roofing nails spaced 75 mm on center.

3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Provide and maintain mechanical application devices with pneumatic tires that operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

3.2.3 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 3 liters per 10 sq. metersor as recommended by roof membrane manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane base flashing applications.

3.2.3.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive roofing and base flashing uniformly with primer. Allow primer to dry before application of roofing and flashing materials.

3.2.3.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roofing system prior to setting in bituminous materials or stripping into roofing system.

3.2.4 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Provide visible working thermometer and thermostatic controls set to the temperature limits. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus one degree C, to check temperatures of the asphalt frequently.

When temperatures exceed maximum specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

3.2.4.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt between 260 and 274 degrees C for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 14 degrees C of the equiviscous temperature (EVT). Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

3.3 APPLICATION

Apply roofing materials as specified unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Except for aggregate surfacing, complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperature for asphalt.

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited.

3.3.2 Base Sheet Application - General

Fully adhere base sheets in accordance with membrane manufacturer's printed instructions. Roll and broom in the base sheet to ensure full contract with the hot asphalt application. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 50 mm unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 150 mm and staggered a minimum of 1 meter. Apply sheets parallel to the roof slope. Extend base sheets approximately 50 mm above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Retrofit roof drains must conform to ANSI/SPRI RD-1. Application must be free of ridges, wrinkles, and buckles.

3.3.3 Ply Felts

Ensure proper alignment of felts prior to installation. Apply ply felts shingle fashion perpendicular to slope of roof, including application on areas of tapered insulation that change slope direction. Bucking or backwater laps are prohibited. Apply felts in a continuous operation. Provide starter sheets of felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions for the number of plies to be installed and in uniform alignment. Lap ends not less than 150 mm and stagger one meter minimum. Place the full width of each ply in hot bitumen immediately behind the bitumen applicator. Plies must be laid free of wrinkles, creases, ridges, or fishmouths. Extend felts approximately 50 mm

above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections. Avoid traffic on mopped surfaces when the bitumen is fluid and for a minimum of one hour after ply application.

3.3.3.1 Hot-Mopping of Ply Felts

Bond plies to each other and to the substrate with hot asphalt. Apply felts immediately following application of asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, asphalt must be completely fluid, with asphalt temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous mopping and firmly bonding film. Apply asphalt at the rate of approximately 13 kg per 10 sq. meters plus or minus 25 percent. Require application rate on the high end of the application range when mopping directly to absorptive insulation substrates of perlite and woodfiber. As felts are rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. Bitumen must be visible beyond all edges of each ply as it is being installed. Individual ply installation and the completed roof membrane system must be free of air pockets, felt delaminations, ridges, creases, fishmouths, dry laps, or blisters. Do not lay felts dry or turn back laps for mopping between plies.

3.3.4 Membrane Flashing

Provide two plies of modified bitumen membrane strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Top ply of flashing must be granule-surfaced modified bitumen membrane. Install flashing after plies of roof membrane felt have been applied but before aggregate surfacing is applied. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of base flashing 150 mm on center through minimum 25 mm diameter tin caps with fasteners of sufficient length to embed minimum 25 mm into attachment substrate. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.3.4.1 Strip Flashing

Set primed flanges of sheet metal flashings to be incorporated into roofing system in a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over the ply felts. Strip-in with one layer of smooth surface modified bitumen membrane and cap with granule-surfaced modified bitumen membrane. Set strip flashing in hot asphalt or cement to the tops of the flanges, roofing membrane, and to each other. Use coatings of asphalt roof cement not less than 1/16 inch thick for ply felt. Use hot asphalt or modified bitumen cement for modified bitumen sheets. Extend first stripping ply not less than 100 mm beyond outer edge of flange onto roof membrane. Extend each additional ply 100 mm beyond the edge of the previous ply.

3.3.4.2 Pre-fabricated Curbs

Anchor prefabricated curbs securely to nailer or other base substrate as indicated and flash with modified bitumen flashing membrane.

3.3.4.3 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.4.4 Lightning Protection

Flash or attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.5 Correction of Deficiencies

Where any form of deficiency is found, take additional measures to determine the extent of the deficiency and corrective actions must be as directed by the Contracting Officer. Where insulation is found to be wet, remove insulation and provide new built-up roofing and insulation.

3.3.6 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 PROTECTION OF APPLIED ROOFING

3.4.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied roofing as follows:

3.4.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.4.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.4.4 Glaze Coat

Use light glaze coating of bitumen to waterproof roof areas requiring extended time to complete. Glaze coating must be at the discretion of the Contracting Officer. Apply bitumen glaze coat on exposed felts at a rate of 0.25 kg to 0.50 kg per square meter. Lower application rates, in

accordance with membrane manufacturer's recommendations, may be required when modified bitumen cap sheet surfacing is specified. Provide valleys and low areas that may pond water with glaze coating.

3.5 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.5.1 Test for Surface Dryness

Before application of insulation or membrane materials and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which materials are to be applied, one pint of asphalt when heated in the range of 176 to 204 degrees C, must not foam upon contact.

b. Strippability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

3.5.2 Construction Monitoring

During progress of the roof work, Contractor is responsible for making visual inspections 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.

Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

The proper number, type, and spacing of fasteners are installed.

Materials comply with the specified requirements.

All materials are properly stored, handled and protected from moisture or other damages.

Asphalt is heated and applied within the specified temperature parameters.

Hot asphalt application is provided uniformly for voidless coverage and as necessary to ensure full adhesion of materials. Materials are set in place while asphalt is within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

Membrane is without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashings and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

3.5.3 Samples of Built-Up Roofing

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing as directed by the Contracting Officer. Take and test samples in accordance with ASTM D 3617 and at locations selected by the Contracting Officer immediately prior to cutting. Cut 100 mm by 1000 mm samples across felt laps in a manner to expose the specified number of plies. The 100 mmedge must coincide with an edge lap of felt and not be positioned over an end lap. Use 100 mm by 1000 mm samples for visual inspection. The Contracting Officer will inspect the samples for the specified number of plies, bond between plies, skips in interply moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. Use 300 mm by 300 mm cut samples to calculate bitumen quantities in accordance with ASTM D 3617 and directed by the Contracting Officer. Do not proceed with surfacing until all deficiencies disclosed as a result of cut tests have been corrected and approved by the Contracting Officer. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area and patch as specified.

3.5.3.1 Number of Cut Tests

Take cut samples as directed by the Contracting Officer for quality assurance validation or as necessary to determine the extent of deficiencies discovered in the construction. Except where cut samples are taken to investigate deficiencies, provide no more than two cut samples per 1000 square meters or one cut sample from each day's work.

3.5.3.2 Sample Cutting Device

Provide a rectangular, 100 mm by 1000 mm template and 300 mm by 300 mm template, of a type that will permit accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.5.3.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks,

insert one ply of ply felt into opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press cutout sample firmly into asphalt roof cement. Repair area of cut with new patch of the same number of plies as the primary roof membrane. Extend the first ply minimum 150 mm all around the cut area. Extend each additional ply minimum 100 mm beyond the previous ply.

3.6 INFORMATION CARD

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 1 mm thick aluminum card for exterior display. Card must be 215 mm by 275 mm minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Provide minimum size information card of 215 mm by 275 mm. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 55 00

PROTECTED MEMBRANE ROOFING (PMR)

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 578	(2010a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 751	(2006) Coated Fabrics

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Reprint Jul 2009) Tests for Uplift Resistance of Roof Assemblies
UL 790	(2004; Reprint Oct 2008) Standard Test Methods for Fire Tests of Roof Coverings

1.2 SYSTEM DESCRIPTION

1.2.1 Wind Uplift Resistance

Wind uplift resistance of the complete roof assembly shall be rated Class I-90 in accordance with UL 580. Wind resistance of loose-laid ballasted system shall be in accordance with FM P9513. Submit drawings required for the membrane, modified to include the complete PMR assembly.

1.2.2 Pre-Roofing Conference

After approval of submittals and before performing roofing and insulation installation work, hold a pre-roofing 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 representatives to roof manufacturer

d.-Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

e.-Quality control plan for the roof system installation

f.-Safety requirements

Pre-roofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with roof work and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Roof Assembly

SD-07 Certificates

Material and Equipment

Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment

submit material supplier's or equipment manufacturer's statement that the supplied insulation, filter fabric and membrane materials meet specified requirements. Each certificate shall be signed by an official authorized to certify on behalf of material supplier or product manufacturer and shall

identify quantity and date or dates of shipment or delivery to which the certificates apply. Submit certificates of compliance for material and equipment, as specified.

1.4.2 Qualifications

Submit documentation verifying a minimum of 2 years experience with PMR systems and certification by the PMR manufacturer as an approved Installer for the specified PMR system.

1.4.3 Fire Resistance

The completed roof system shall be rated Class A as determined by UL 790 or Class I as determined by FM APP GUIDE. Compliance of each component of the roofing system shall be evidenced by the label or written certification from the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

Store insulation away from areas where welding is being performed or where contact with open flames is possible. Shield insulation from extended exposure to sunlight. Remove materials damaged by moisture from the site. Ballast shall not be stored on the roof.

PART 2 PRODUCTS

2.1 UNDERLAYMENT

Underlayment will be concrete.

2.2 ROOF MEMBRANE

Roof membrane shall be in accordance with Section 07 51 13 ASPHALT BUILT-UP ROOFING.

2.3 INSULATION ABOVE THE MEMBRANE

Insulation placed above the membrane shall be extruded polystyrene. Insulation shall be a standard product of the manufacturer, and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, and the thickness. Boards shall be marked individually. The thermal resistance of the insulation shall be not less than the R-value shown on the drawings. Insulation shall conform to ASTM C 578, Type V, VI or VII and shall be intended by the manufacturer for use above a protected roof membrane. Bottom layer of insulation shall provide drainage paths, mostly parallel to the slope, between insulation and membrane. Top layer of insulation may have ribbed top surfaces when flat-bottom pavers are used as ballast.

2.4 FILTER FABRIC

Filter fabric shall be either woven or non-woven pervious sheet of long chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride, formed into a pattern with distinct and measurable openings. The filter fabric shall provide an ASTM D 4751 Apparent Opening Size (AOS) no finer than the 0.125 mm sieve and no coarser than the 0.212 mm sieve. Edges of fabric shall be selvaged or otherwise finished to prevent raveling. Fabric shall have minimum weight of 102 gms/sq. m and shall conform to the following table:

Property	Test Procedure	Result
Tensile strength	ASTM D 5034 Grab test method using 25 mm square jaws and a travel rate of 5 mm per sec	29 kg/25 mm minimum in any principal direction
Puncture strength	ASTM D 751 - Tension testing machine with ring clamp; steel ball replaced with a 8 mm diameter solid steel cylinder with a hemi-spherical tip centered within the ring clamp	18 kg minimum load

2.5 BALLAST

Ballast shall be precast concrete pavers. Size and placement shall be as indicated.

2.5.1 Pavers

Concrete pavers shall be minimum 75 mm thick, having 21 MPa minimum compressive strength. Pavers shall be ribbed on the bottom for use over smooth topped insulation and flat on the bottom for use over insulation with ribbed top.

PART 3 EXECUTION

3.1 INSTALLATION

Install roof membrane and flashing in accordance with Sections 07 51 13 ASPHALT BUILT-UP ROOFING.

3.2 FLOOD TEST

After the membrane and its flashings are installed, and before the insulation is placed above the membrane, plug the drains and flood the roof with water for 24 hours. Leaks shall be remedied before insulation is installed.

3.3 INSULATION

Insulation shall be loose laid on the membrane after the membrane is completed and flood coat (if any) is cool. When required by the manufacturer of the insulation, a slip sheet shall be installed over the membrane. Drainage paths shall be provided between the lower surface of the insulation and the membrane. Most of the drainage paths shall be parallel to the slope of the roof. Unless otherwise specified by the manufacturer, end joints shall be staggered. Joints between boards shall not exceed 6 mm. Insulation shall be installed to within 19 mm of projections and cant strips.

3.4 FILTER FABRIC INSTALLATION

Filter fabric shall be laid loose over insulation, smooth and free of tension and stress. Edges and ends shall be lapped a minimum of 300 mm and extended above the ballast 50 to 75 mm at the perimeter and penetrations.

Joints parallel to perimeter will not be permitted within 1.8 meters of the perimeter.

3.5 BALLAST INSTALLATION

Pavers shall be installed where indicated. Ballast buggy wheels are not allowed on the membrane.

3.6 INSPECTION

Establish and maintain an inspection procedure to ensure compliance of the installed roof with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.

b. Verification of compliance of materials before, during, and after installation, proper storage and handling of insulation.

c. Inspection of mechanical fasteners; type, number, length, and spacing.

d. Coordination with other materials, cants, nailers, flashings, and penetrations.

e. Inspection of proper placement of insulation, joint orientation and laps between layers, joint widths and bearing of edges of underlayment on deck.

f. Inspection of proper placement of pavers and amount and leveling of ballast.

Submit procedures for approval, prior to start of roofing work including a checklist of points to be observed. The actual inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2008) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 221M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 32	(2008) Standard Specification for Solder Metal
ASTM B 370	(2009) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

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

SMACNA 1793	(2003) Architectural Sheet Metal Manual, 6th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with

roofing work to permit continuous roofing operations.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Downspouts; G

Counterflashing; G

Flashing at roof penetrations; G

Reglets; G

Scuppers; G

Drip edge; G

Conductor heads

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA Arch. Manual for a particular item, unless otherwise specified or indicated. Conform to the requirements specified and to the thicknesses and configurations established in SMACNA Arch. Manual for the materials. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper.

Furnish sheet metal items in 2400 to 3000 mm lengths. Single pieces less than 2400 mm long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 300 mm legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: scuppers, including hangers; downspouts; and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Copper, Sheet and Strip

ASTM B 370, cold-rolled temper, H 00 (standard).

2.1.4 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A653/A653M.

2.1.4.1 Finish

Exposed exterior items of zinc-coated steel sheet must have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.020 to 0.033 mm and color as selected by Contracting Officer.

2.1.5 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.6 Aluminum Alloy Sheet and Plate

2.1.6.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on one side unless otherwise indicated.

a. Scuppers, downspouts, and hangers

b. Gravel stops and fascias

c. Flashing

2.1.6.2 Finish

Exposed exterior sheet metal items of aluminum must have a baked-on,

factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.020 to 0.033 mm and color as selected by Contracting Officer.

2.1.7 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221M.

2.1.8 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.9 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.10 Asphalt Primer

ASTM D41/D41M.

2.1.11 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 13 mm hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 450 mm. Confine nailing of flashing to one edge only. Space nails evenly not over 75 mm on center and approximately 13 mm from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

3.1.3 Cleats

Provide cleats for sheet metal 450 mm and over in width. Space cleats

evenly not over 300 mm on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 50 mm wide by 75 mm long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pretin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 1.0 mm or less in thickness.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 20 mm wide.

3.1.5.2 Lap Seams

Finish soldered seams not less than 25 mm wide. Overlap seams not soldered, not less than 75 mm.

3.1.5.3 Loose-Lock Expansion Seams

Not less than 75 mm wide; provide minimum 25 mm movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 3 mm thick bed.

3.1.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pretin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.6.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Seal the joints in aluminum sheets of one mm or less in thickness with specified sealants. Do not solder aluminum.

3.1.7 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than one mm. Aluminum one mm or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.7.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.7.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 300 mm maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 50 mm from the end of the overlapping sheet.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.8.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.8.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 9750 mm intervals for aluminum and at not more than 12 meter intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 3600 mm apart.

3.1.10 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 230 to 250 mm above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 75 mm. Fold the exposed edges of counterflashings 13 mm. Where stepped counterflashings are required, they may be installed in short lengths a minimum 200 mm by 200 mm or may be of the preformed one-piece type.

Provide end laps in counterflashings not less than 75 mm and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 3000 mm. Form the flashings to the required shapes before installation. Factory-form the corners not less than 300 mm from the angle. Secure the flashings in the reglets with lead wedges and space not more than450 mm apart; on short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 6 mm and extend not less than 50 mm into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.11 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 6 mm and a depth of 30 mm, as approved.

3.1.11.1 Caulked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 450 mm, caulked full and solid with an approved compound.

3.1.11.2 Friction Reglets

Provide with flashing receiving slots not less than 16 mm deep, 25 mm jointing tongues, and upper and lower anchoring flanges installed at 24 inch maximum snaplock receiver. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool, wedges, and filled with a sealant. For friction reglets, install flashing snaplock receivers at 24 inch on center maximum. When the flashing has been inserted the full depth, caulk the slot and lock with wedges and fill with sealant.

3.1.12 Metal Drip Edge

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 75 mm and secure with compatible nails spaced not more than250 mm on center along upper edge.

3.1.13 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry or concrete substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 3000 mm lengths. Provide end joints to telescope not less than 13 mm and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than 25 mm away from walls. Fasten to the walls at

top, bottom, and at an intermediate point not to exceed 1500 mm on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.13.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.14 Scuppers

Line interior of scupper openings with sheet metal. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than 25 mm against the face of the outside wall at the top and sides. Fold outside edges under 13 mm on all sides. Provide the perimeter of the lining approximately 13 mm less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.15 Conductor Heads

Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 100 mm long. Flat-lock solder the seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 50 mm wider than the scupper. Attach conductor heads to the wall with masonry fasteners, and loose-lock to provide conductor heads with screens of the same material. Securely fasten screens to the heads.

3.1.16 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.17 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 75 mm on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 50 mm. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 100 mm roof flange in bituminous plastic cement and nailed 75 mm on center. Extend sleeve a minimum of 200 mm above the roof deck and lapped a minimum of 75 mm by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, kilograms Per Square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Building Expansion Joints Cover.....	4.9	0.81	0.38	0.38	0.6
Waterstop-bellows or flanged, U-type.....	4.9	-	0.38	0.38	-
Downspouts and leaders.....	4.9	0.81	0.38	0.38	0.6

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, kilograms Per Square meter	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Steel, mm
Downspout clips and anchors.....	-	1.02 clip	-	-	-
	-	3.175 anchor	-	-	-
Downspout straps, 50 mm.....	14.7(a)	1.52	1.27	-	-
Conductor heads.....	4.9	0.81	0.38	0.38	-
Scupper lining.....	6.125	0.81	0.38	0.38	-
Strainers, wire diameter or gage....	4.0 gage	3.66 diameter	2.77 diameter		-
Flashings:					
Cap (Counter-flashing)	4.9	0.81	0.38	0.38	0.5

(a) Brass.

(b) May be lead weighing 19.6 kilograms per square meter.

(c) May be polyvinyl chloride.

(d) 12.25 kilogram minimum lead sleeve with 100 mm flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS
TYPE OF JOINT

Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	30 mm single lock, standing seam, cleated	30 mm single lock, standing	- - -
Flashings			
Base	25 mm 75 mm lap for expansion joint	25 mm flat locked, soldered; sealed; 75 mm lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal

TABLE II. SHEET METAL JOINTS
TYPE OF JOINT

Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
			expansion joint with a joint sealing compound compound.
Cap-in reglet	75 mm lap	75 mm lap	Seal groove with joint sealing compound.
Reglets	Butt joint	- - -	Seal reglet groove with joint sealing compound.
Eave	25 mm flat locked, cleated. 25 mm loose locked, sealed expansion joint, cleated	25 mm flat locked, locked, cleated 25 mm loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	75 mm lap	75 mm lap	- - -
Valley.	150 mm lap cleated	150 mm lap cleated	- - -
Edge strip	Butt	Butt	- - -
Gravel stops:			
Extrusions	- - -	Butt with 13 mm space	Use sheet flashing beneath and a cover plate.
Sheet, smooth	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing backup plate.
Sheet corrugated	Butt with 6 mm space	Butt with 6 mm space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	40 mm lap, riveted and soldered	25 mm flat locked, riveted, and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.

(a) Provide a 75 mm lap elastomeric flashing with manufacturer's

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	TYPE OF JOINT: Aluminum	Remarks

recommended sealant.

(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.

-- End of Section --

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E 119	(2010b) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	(1997; R 2009) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2007) Fire-Resistive Joint Systems
ASTM E 2174	(2010a) Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E 2307	(2010) Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E 2393	(2010a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
ASTM E 814	(2011) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2010b) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM AS 4991	(2001) Approval of Firestop Contractors

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Reprint Mar 2010) Fire Tests of Through-Penetration Firestops

UL 2079	(2004; Reprint Jun 2008) Tests for Fire Resistance of Building Joint Systems
UL 723	(2008; Reprint Sep 2010) Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2011) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

1.2.1 General

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2.2 Sequencing

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.2.3 Submittals Requirements

a. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F"

"T" and "L" ratings, and type of application.

b. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification from UL of passing the "Aging and Environmental Exposure Testing " portion of UL 1479.

c. Submit documentation of training and experience for Installer.

d. Submit manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Firestopping Materials; G.

SD-07 Certificates

Manufacturer's Technical Representative
Firestopping Materials.
Installer Qualifications; G.
Inspection; G.

1.4 QUALITY ASSURANCE

1.4.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer written certification of training, and retain proof of certification for duration of firestop installation.

1.4.2 Manufacturer's Technical Representative

The manufacturer's technical representative shall be a direct representative of the manufacturer (not a distributor or an agent). Provide current documentation from the manufacturer that he or she is a

direct representative of the manufacturer and is qualified to preform the specified inspections and certify the firestopping installation.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements. Remove damaged or deteriorated materials from the site.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic, water-based, noncombustible products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment. Firestop material must be free from Ethylene Glycol, PCB, MEK, or other types of hazardous chemicals.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

b. Penetrations of Fire Resistance Rated Floors and Roof-Ceiling Assemblies: F Rating = 1 hour, T Rating = 1 hour. Where the penetrating item is outside of a wall cavity the F rating and T rating must be equal to the fire resistance rating of the floor penetrated.

c. Penetrations of Fire and Smoke Resistance Rated Walls, Floors,

Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = 1 hour, T Rating = 1 hour and L Rating = <5 cfm/sf Where L rating is required.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Material Performance

All firestop materials are subject to these minimum standards of performance.

a. Firestop material shall be capable of installation at temperatures of 2 to 49 degrees C.

b. Material must be able to be frozen, thawed and still maintain manufacturer approval for installation.

c. Firestop material must convey a manufacturer's written warranty guaranteeing the performance of the material for the sustainable lifetime of the structure.

d. Material must maintain a shelf life of no less than 2 years form date of manufacturing.

e. Acceptable firestop cast-in-place devices are factory assembled intumescent lined round or oval plastic cylinders capable of protecting plastic, metallic, cable, and blank openings through the cast-in-place device equal to the fire-resistance rating of the floor.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more

in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products. Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0% to 100% visual fill of penetrants; while maintaining "L" rating of <5 cfm/sf measured at ambient temperature and 400* F at 0% to 100% visual fill. Each device must be capable of retrofit applications and be available in square and round configurations, with single, double, triple and six-plex bracket systems provided. Firestop devices must also allow for plastic pipe, metallic pipe, and mixed multiple penetrations through a single device.

3.3 INSPECTION

3.3.1 General Requirements

The firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM standards for firestop inspection, and document inspection results to be submitted to GC, Architect and Owner.

a. ASTM E 2393

b. ASTM E 2174

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS

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	(2010) Standard Specification for Solvent Release Agents
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
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	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 217	(2010) Cone Penetration of Lubricating Grease
ASTM E 84	(2010b) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

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

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

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

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 4 and 32 degrees C.

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 32 degrees C or less than 4 degrees C.

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.

1.6 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. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As selected
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As selected
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	As selected
e.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected
f.	Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	As selected
g.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	As selected
h.	Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	As selected

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM 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.	Expansion and control joints.	Match adjacent surface color
d.	Interior face of expansion joints in	Match adjacent

LOCATION	COLOR
exterior concrete or masonry walls where metal expansion joint covers are not required.	surface color
e. Voids where items pass through exterior walls.	Match adjacent surface color
f. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
g. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
h. 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. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Gray

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.

2.2 PRIMERS

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

2.3 BOND BREAKERS

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

2.4 BACKSTOPS

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

backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 2, closed cell, Class A, Grade round for cellular rubber sponge backing.

2.4.2 PVC

Conform to ASTM D 1667, Grade VO 12, open-cell foam, round for Polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Conform to ASTM C 509, Option II, Type II preformed rods or tubes for Synthetic rubber backing.

2.4.4 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.4.5 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C 1311.

2.4.6 Silicon Rubber Base

Provide Silicon Rubber Based Sealants of single component, solvent release, color as selected, conforming to ASTM C 920, Non-sag, Type S, Grade NS, Class 25.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

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

3.1.1 Steel Surfaces

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

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For

removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

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

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

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

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
6 mm (minimum)	6 mm	6 mm
over 6 mm	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
6 mm (minimum)	6 mm	6 mm
Over 6 mm to 13 mm	6 mm	Equal to width
Over 13 mm to 50 mm	50 mm	16 mm
Over 50 mm	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

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

3.3.6 Sealants

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

3.4 PROTECTION AND CLEANING

3.4.1 Protection

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

3.4.2 Final Cleaning

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

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

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

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

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	(2006) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM E 1300	(2009a) Determining Load Resistance of Glass in Buildings
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 F 2248	(2009) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2008) Standard Methods of Fire Tests of Door Assemblies

NFPA 80	(2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR A250.11	(2001) Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.6	(2003; R2009) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10C	(2009) Standard for Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 General Performance

Exterior steel doors and frames shall be designed to withstand the effects of the following performance requirements without exceeding performance criteria or failure.

1.4.2 Delegated Design

Design steel door and frame systems, including comprehensive engineering analysis by a qualified professional engineer using performance requirements and design criteria indicated.

1.4.3 Blast Resistance

1.4.3.1 Framing System Deflection

Provide steel door and frame system where framing members restrict the deflections of the edges of the door support to 1/160 of the length of the support edge at allowable stress levels under the equivalent 3-second design loading.

1.4.3.2 Connection Design

Connections must be capable of preventing the frame from being dislodged from support structure elements when subject to the equivalent 3-second design loading.

1.4.3.3 Explosive Design Load

The equivalent 3-second design loading shall be determined using ASTM F 2248 and based upon the following: (Per Table B-1 - Standoff Distances for New and Existing Buildings, UFC-4-010-001 - DoD Minimum Anti-Terrorism Standards for Building).

a. Building Category: Primary Gathering Building
b. Applicable Level of Protection: Low
c. Conventional Construction Standoff Distance: 25m
d. Applicable Explosive Weight: II

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated. Provide exterior glazing in accordance with ASTM F 2248 and ASTM E 1300.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Exterior Extra Heavy Duty Doors - Type HMD-E

SDI/DOOR A250.8 and NAAMM HMMA HMM, Level 4, Physical Performance Level A, Model 2, with solid oak core construction of size(s) and design(s) indicated and meeting the requirements of CENTCOM OPORD 97-01, Annex C, Appendix 2 as well as meeting the requirements of ASTM 470 Grade 10. Doors shall provide a minimum STC Rating of 45. Doors shall be constructed of 3mm (11 gauge), G60 galvanized steel and shall open outwards.

2.1.1.2 Interior Heavy Duty Security Doors - Type HMD-S

SDI/DOOR A250.8 and NAAMM HMMA HMM, Level 3, Physical Performance Level A, Model 2, with solid oak core construction of size(s) and design(s) indicated. Doors shall provide a minimum STC Rating of 45. Doors shall be constructed of 1.5mm (16 gauge), G60 galvanized steel.

2.1.1.3 Interior Fire Rated Heavy Duty Security Doors - Type HMD-SF

SDI/DOOR A250.8 and NAAMM HMMA HMM, Level 3, Physical Performance Level A, Model 2, with solid oak core construction as recommended by the manufacturer for interior fire doors. Doors shall be constructed of 1.5mm (16 gauge), G60 galvanized steel. Doors shall have the fire rating indicated.

2.1.1.4 Interior Doors - Type HMD

SDI/DOOR A250.8 and NAAMM HMMA HMM, Level 3, Physical Performance Level A, Model 2, with core construction as recommended by the manufacturer for interior doors, of size(s) and design(s) indicated. Doors shall be constructed of 1.5mm (16 gauge), G60 galvanized steel.

2.2 SOUND RATED STEEL DOORS

Doors shall have a Sound Transmission Class (STC) of 45 as indicated on the drawings.

2.3 ACCESSORIES

2.3.1 Louvers

2.3.1.1 Interior Louvers

SDI/DOOR 111 (Type HMD-L), Louvers shall be stationary sightproof and lightproof type. Louvers for lightproof doors shall not transmit light. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 0.9 mm thick steel and louver blades of a minimum 0.6 mm. Louvers for

lightproof doors shall have minimum of 20 percent net-free opening.

2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 3 and 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, unless otherwise indicated.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.4.2 Knock-Down Frames (Contractor Option)

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.4.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick. Exterior door frames shall be anchored as required to meet FE/BR rating of 15 minutes.

2.4.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;

2.5 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

2.5.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10C. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.5.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and

frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.6 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.6.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 2.19 by 10-5 cubic meters per second of air per square meter of door area when tested in accordance with ASTM E 283.

2.7 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES

2.8.1 Factory-Primed Finish (Interior Doors)

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8.

2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish (Exterior Doors)

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. The coating weight shall meet or exceed the minimum requirements for coatings having 122 grams per square meter, total both sides, i.e., ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.8.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.9 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance,

and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.9.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
Door thickness	1-3/4 inch	44.5 mm
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	16 gage	1.5 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
Anchor bolts	3/8 inch	10 mm

-- End of Section --

SECTION 08 34 01

FORCED ENTRY RESISTANT COMPONENTS

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

AMERICAN WELDING SOCIETY (AWS)

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

ASM INTERNATIONAL (ASM)

ASM STFA	(2001; 6th Ed) The Surface Treatment and Finishing of Aluminum and Its Alloys (2 Vol.)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D 3951	(2010) Commercial Packaging
ASTM E 90	(2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2006) Butts and Hinges
ANSI/BHMA A156.115	(2006) Hardware Preparation in Steel Doors and Steel Frames
ANSI/BHMA A156.13	(2005) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2008) Auxiliary Hardware
ANSI/BHMA A156.18	(2006) Materials and Finishes

ANSI/BHMA A156.4	(2008) Door Controls - Closers
ANSI/BHMA A156.5	(2010) Auxiliary Locks and Associated Products

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 801	(2005) Glossary of Terms for Hollow Metal Doors and Frames
NAAMM HMMA 802	(2007) Manufacturing of Hollow Metal Doors and Frames
NAAMM HMMA 810	(2009) Hollow Metal Doors
NAAMM HMMA 820	(2008) Hollow Metal Frames
NAAMM HMMA 830	(2002) Hardware Selection for Hollow Metal Doors and Frames

U.S. DEPARTMENT OF STATE (SD)

SD Std-01.01	(1993 Rev G Amended; Inx Certified Prod/Mfg) Certification Standard Forced Entry and Ballistic Resistance of Structural Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Components covered in this specification are designed to resist forced entry attacks with increasing severity levels of hand, power, and thermal tools and weapons and explosives. The components include forced entry resistant personnel door/frame assemblies. Each type of forced entry resistant component shall be a complete assembly produced by a single manufacturer. Movable and operable components shall operate smoothly and freely. Items for exterior installation shall be designed to resist water and vapor penetration or entrapment. Submit manufacturer's descriptive data, installation instructions, and certificate and test report showing compliance with the specified forced entry test standard as specified in paragraph COMPONENT TEST REQUIREMENTS for all components. Manufacturer's certificate shall be submitted indicating that compliance with the installation instructions and drawings will provide the specified degree of forced entry resistance.

1.2.2 Other Submittal Requirements

The following shall be submitted:

a. Manufacturer's descriptive data and finish samples.

b. The forced entry resistant door lock functions, for selection by the Contracting Officer.

c. Manufacturer's certificates attesting that components conform to the requirements on drawings and in specifications.

d. Testing reports from independent testing laboratories indicating conformance to regulatory requirements.

e. Certificate indicating compliance with the requirements for doors of the type and fire rating class.

f. Manufacturer certification that compliance with the installation instructions and/or drawings will provide the specified degree of forced entry resistance.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Installation; G

SD-03 Product Data

Forced Entry Resistant Components
Installation
Components

SD-07 Certificates

Forced Entry Resistant Components; G

1.4 QUALITY ASSURANCE

Qualify welding procedures, welders, and welding operators in accordance with AWS D1.1/D1.1M. Forced entry resistant components shall be certified as resistant to the forced entry test standards indicated herein. Forced entry resistant components shall be tested as specified below. The test results and certification thereof shall be approved by the Contracting Officer before delivery of the component to the job site.

Component	Test Standard	Level Within Test Standard (If Any)	Minimum Attack Time (Minutes)
Doors	SD Std-01.01	15 Minute	15

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver Components to the job site with the manufacturer's name, and model number clearly marked thereon. Components shall be delivered, stored, and handled so as not to be damaged or deformed and shall be in accordance with ASTM D 3951. Components shall be handled carefully to prevent damage to

the faces, edges, corners, ends, and glazing where applicable. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection of the damage. Replace damaged components that cannot be restored. Components and equipment shall be stored in a dry location on platforms or pallets that are ventilated adequately, free of dust, water, and other contaminants, and stored in a manner which permits easy access for inspection and handling. Submit lists including schedule of components to be incorporated in the work with manufacturer's model or catalog numbers, specification and drawing reference numbers, warranty information, threat level designated, sound transmission coefficient ratings, insulation "U" value, and number of items provided. Listing of similar products that have been satisfactorily in use for two years or more, including name of purchasers, locations of installations, dates of installations, and service organizations.

1.6 SEQUENCING AND SCHEDULING

When testing of a previously untested component is specified, allow sufficient lead time so that testing will not delay construction. The test results and component shall be approved by the Contracting Officer before delivery of the component to the job site.

1.7 WARRANTY

Manufacturer's warranty for 5 years shall be furnished for glazing materials. Warranty shall provide for replacement and installation of glazing if delamination, discoloration, or cracking or crazing occurs.

PART 2 PRODUCTS

2.1 COMPONENTS

Each type of forced entry resistant component shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall duplicate items that have been tested and approved in accordance with the forced entry test standard specified in paragraph COMPONENT TEST REQUIREMENTS.

2.2 FORCED ENTRY RESISTANT PERSONNEL DOOR AND FRAME ASSEMBLIES

Doors and frames shall be factory fabricated assemblies of indicated sizes. Doors shall be of steel, hardened steel, or be reinforced internally with steel shapes and clad with aluminum. Interior composition and reinforcement shall be determined by the manufacturer. Rubber silencers shall be installed on door frames. Exterior doors shall have top edges closed flush and sealed against water penetration, be insulated, and provided with weatherstripping and thresholds. Locks and hinges shall be the same or equal in performance and number as the hardware used on the tested door. Lock and hardware shall be provided by the manufacturer as a complete assembly. Frames shall be furnished by the door fabricator, with anchorage to wall construction completely specified as to number of anchors, anchor size, material, and length.

2.2.1 Sound Rated Doors

Provide sound rated doors at locations indicated. Door assemblies shall comply with the forced entry test standard specified and shall consist of door, hardware, frame, threshold, and adjustable gaskets. The assembly shall have a laboratory Sound Transmission Class (STC) rating of 45 when

tested in accordance with ASTM E 90. Submit manufacturer's descriptive data, test report, and certification of the test report showing compliance with the specified requirements.

2.2.2 Door and Frame Fabrication

The subsurfaces shall be flat, parallel, and plumb after fabrication. Doors shall be reinforced in accordance with manufacturer's design. Door frames shall be anchored as specified by the door manufacturer. Coordinate the door manufacturer's requirements for welding to wall reinforcement or casting frame embedments into wall before wall is placed. Steel door frames shall be mitered or coped and welded at the corners with welds ground smooth. Where structural channel frames are used the size, weight, stops, welding, and anchorage into surrounding construction shall be specified and tested along with the door as an assembly. Any necessary reinforcements in the door and the frame shall be made in the factory. Door and frame shall be drilled and tapped as required for the specified hardware. Frame channels shall be mitered or coped and welded at corners with full penetration groove welds. Exposed welds shall be dressed smooth. Hollow metal doors and frames shall be manufactured in accordance with NAAMM HMMA 801, NAAMM HMMA 802, NAAMM HMMA 810, and NAAMM HMMA 820 as a standard of quality, and shall meet the specified forced entry testing standard.

2.2.3 Preparation for Hardware

Prepare doors and frames for hardware in accordance with NAAMM HMMA 830. Surface applied hardware shall be drilled and tapped in the field.

2.2.4 Hardware

Hardware for forced entry resistant door assemblies shall be provided by the door assembly manufacturer to ensure a complete forced entry resistant assembly. Where test standard requires hardware to be tested with the door assembly, locks and hinges shall be included in the labeling and/or test certification. Locks and hinges shall be the same or equal in performance, quality, grade, and quantity as used on the successfully tested door assembly in accordance with the specified forced entry testing standard. Provide certification that the locks, latches, and hinges provide the same degree of forced entry resistance as required by the specified forced entry testing standard. Keying shall be as specified in Section 08 71 00 DOOR HARDWARE.

2.2.4.1 Locks and Latchsets

The door manufacturer shall submit available lock functions for selection of function by the Contracting Officer. Mortise lock and latchsets shall be, as a minimum, series 1000, operational Grade 1, Security Grade 1 or 1A, and shall conform to ANSI/BHMA A156.13. Strikes for mortise locks and latches (including deadbolt locks), as a minimum, shall conform to ANSI/BHMA A156.115 except strikes shall be rectangular (without curved lip). Mortise-type locks and latches for doors 45 mm thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts. Mortise locks and latches shall have full escutcheon, through-bolted, extruded stainless steel trim. Lock finish shall be 630 in accordance with ANSI/BHMA A156.18.

2.2.4.2 Hinges

Steel doors and frames required to resist the "very low" or "low" threat severity level that are up to and including 2.13 m high shall, as a minimum, be equipped with three Grade 1 hinges in accordance with ANSI/BHMA A156.1, minimum size 125 mm high, heavy, double, or triple weight as required for weight of door. For each additional 300 mm of door height beyond 2.13 m, provide a minimum of one more hinge. Hinges shall be full mortise, half mortise, full surface, or half surface design as recommended by the manufacturer for frame and door design and shall be tamperproof unless mounted on the protected side of the door. Hinges shall have security pins and be equipped with a safety stud. Spot welding of hinge pin will not be acceptable. Provide hinge manufacturer's certification that the hinge supplied meets applicable test requirements for ANSI/BHMA A156.1 type number of hinge specified and that the hinge is suitable for the size and weight of the door assembly on which it will be utilized. Continuous extra heavy-duty piano-type hinge sized to carry the weight of the door without sagging is permitted. If continuous piano-type hinges are provided with the door, independent laboratory reports covering both the door weight capacity and a 2,500,000 cycle testing to match the ANSI/BHMA A156.1 Grade 1 requirements shall be furnished by the Contractor. Interior door hinges shall be furnished in prime coated steel. Exterior door hinges shall be furnished in nonferrous metal or stainless steel.

2.2.4.3 Electric Strikes

Where required, provide electric strikes conforming to ANSI/BHMA A156.5 Grade 1. Furnish strike boxes with deadbolt and latch strikes for Grade 1. Strikes shall be fail secure.

2.2.4.4 Door Closers

Closers shall be extra heavy duty of size and type recommended by the manufacturer and shall be Grade 1 conforming to ANSI/BHMA A156.4. Door closer finish shall be 600 in accordance with ANSI/BHMA A156.18.

2.2.4.5 Door Stops and Holders

Door stops shall be extra heavy duty, conforming to ANSI/BHMA A156.16, Type L11251 for floor mounted installation.

2.2.5 Frame Anchors

Provide jamb and head anchors with door/frame assembly as specified by the manufacturer and forced entry resistant to the same degree as the component. Coordinate concrete work with component manufacturers when the manufacturer specifies frame anchors to be embedded into a concrete or concrete masonry unit surface during construction.

2.2.6 Weatherstripping

Provide head and jambs of exterior doors with compression-type neoprene bulb or closed-cell neoprene adjustable type weatherstripping. Door stops shall be weatherstripped with a surface-mounted sponge neoprene strip in bronze housing not less than 1.78 mm thick installed to make contact with the door. Install weatherstripping in conformance with the manufacturer's directions after completion of finish painting.

2.3 ACCESSORIES

Provide accessories for the installation of components into the surrounding structure. Anchorage shall be forced entry resistant to the same degree as the component. Installation shall be in accordance with the manufacturer's recommended instructions. Materials, parts, bolts, anchors, supports, braces, fasteners, and connections necessary for completion of the work.

2.4 LABELING

Forced entry resistant components shall be plainly and permanently labeled as to the applicable forced entry test standard and level within the test standard under which the component was tested and approved. Label shall be visible only from the protected side after component installation and shall include the following information: (1) manufacturer's name or identifying symbol; (2) model number, control number, or equivalent; (3) date of manufacture with the week, month or quarter, and year (this may be abbreviated or be in a traceable code such as the lot number); (4) correct mounting position (by removable label); and (5) forced entry resistant rating by indicating the test standard, level within the test standard (if any), and minutes of attack time withstood (if variable in the standard).

2.5 SHOP/FACTORY FINISHING

Unless otherwise specified, all factory or manufactured components shall be shop finished as indicated below.

2.5.1 Ferrous Metal

Surfaces of ferrous metal, except galvanized and stainless steel surfaces, shall be cleaned and factory primed for painting. Finish painting shall be in accordance with Section 09 90 00 PAINTS AND COATINGS. Prior to shop painting, clean surfaces with solvents to remove grease and oil and with power wire-brushing or sandblasting to remove loose rust, loose mill scale, and other foreign substances. Surfaces of items to be embedded in concrete shall not be shop painted.

2.5.2 Galvanizing

Items specified to be galvanized shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A123/A123M or ASTM A653/A653M.

2.5.3 Aluminum

Unless otherwise specified, aluminum items shall be standard mill finish. When anodic coatings are specified, coatings shall conform to ASM STFA, with treatment to a coating thickness not less than that specified for protective and decorative type finish in AA DAF-45. Items to be anodized shall receive a polished satin finish pretreatment and a clear lacquer overcoat conforming to the above-referenced standard.

PART 3 EXECUTION

3.1 EXAMINATION

Field verify dimensions of rough openings for components and that surfaces of openings are level, plumb, and provide required clearances. Components shall be examined for racking, twisting, and other malformation and

corrected prior to installation. Replace damaged components that cannot be corrected. Protect surrounding work prior to installation of forced entry resistant components. Surrounding work, which is damaged as a result of the installation of forced entry resistant components, shall be repaired in an approved manner prior to acceptance. Protect glazed units from damage during adjacent work.

3.2 FABRICATION

Components shall be constructed, assembled, welded, and equipped with all hardware and accessories required to complete the assembly in the shop of a competent fabricator.

3.3 FASTENERS

Fasteners exposed to view shall match in color and finish and shall harmonize with the material to which fasteners are applied. Holes for bolts and screws shall be drilled or neatly punched. Poor matching of holes shall be cause for rejection of the work. Fasteners shall be concealed where practicable. Unless otherwise specified, fasteners shall conform to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.4 CORROSION PROTECTION - DISSIMILAR MATERIALS

Contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood, or absorptive materials subject to wetting shall be given a protective coating in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.5 INSTALLATION

The finished work shall be free from defects. Components shall be installed plumb and level and secured rigidly in place. Components shall be installed in accordance with approved manufacturer's recommended instructions. Operable parts of components shall be tested for smooth operation in the presence of the Contracting Officer. Coordinate frame embedments into the construction where required by the component manufacturer. Materials which incur damage as a result of adjacent finish work shall be replaced or repaired as specified above. Window assemblies, which are not specified as factory glazed, shall have glazing installed in accordance with GANA Glazing Manual and the manufacturer's recommended instructions. Field glazing shall occur only after concrete, masonry, ceiling, electrical, mechanical, plumbing and adjacent finish work has been completed. The Contractor is responsible for proper installation of forced entry resistant door assemblies so that operating clearances and bearing surfaces conform to the manufacturer's instructions. The bottom of door frames shall be secured to the floor slab in accordance with the manufacturer's recommendations. Weatherstripping and thresholds shall be installed at exterior door openings to provide a weathertight installation. Submit Drawings showing (1) anchorage of components and appurtenances into the actual surrounding construction, (2) clearances for operation, and (3) hardware location and installation details. Submit complete drawings for forced entry resistant prefabricated guardhouses. Submit a copy of installation instructions and recommended cleaning and maintenance instructions.

3.6 MANUFACTURER'S FIELD SERVICES

The manufacturer shall provide the services of a manufacturer's

representative who is experienced in the installation, adjustment, and operation of the component specified. At the request of the Contracting Officer, the representative shall supervise the installation, adjustment, and operation (if operable) of the component. The representative shall be onsite 1 working day.

3.7 ADJUSTING/CLEANING

Adjustments shall be made to assure smooth operation. Units shall be weathertight when closed and locked. All Components shall be cleaned in accordance with manufacturer's instructions. Only cleanser recommended by the manufacturer shall be used to clean polycarbonate, plastic, and applied hardcoats.

-- End of Section --

SECTION 08 34 73

SOUND CONTROL DOOR ASSEMBLIES

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 A1008/A1008M	(2010) 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 A568/A568M	(2009a) Standard Specifications for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM D 6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E 1289	(2008) Standard Specification for Reference Specimen for Sound Transmission Loss
ASTM E 336	(2010) Measurement of Airborne Sound Insulation in Buildings
ASTM E 413	(2010) Rating Sound Insulation
ASTM E 90	(2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2009; TIA 09-1; TIA 09-2) Life Safety Code
NFPA 252	(2008) Standard Methods of Fire Tests of Door Assemblies

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Submit fabrication drawings for the following:

Hollow Metal Sound Retardant Doors

Door Frames

SD-03 Product Data

Submit Manufacturer's catalog data including STC ratings, and UL fire rating, where applicable, for the following items:

Hollow Metal Sound Retardant Doors

Door Frames

Door Hardware

Thresholds

SD-06 Test Reports

Submit test reports for the following in accordance with paragraph entitled, "Guarantee," of this section.

Wind Loading Tests

Water Leakage Tests

Acoustical Tests

Air Infiltration Tests

Positive Pressure Tests

SD-07 Certificates

Submit Certificates for the following items and accessories showing conformance with the referenced standards contained in this section.

Hollow Metal Sound Retardant Doors

Door Frames

Door Hardware

Thresholds

1.3 COMPLIANCE, TESTING, AND GUARANTEE

1.3.1 Compliance And Labeling

1.3.1.1 Category A Positive Pressure Fire Door Construction

Where requirements for positive pressure are met, include for doors all requirements as part of the door construction per Category A guidelines as

published by ITS/Warnock-Hersey. No intumescent is allowed on the frame. Only smoke gasketing applied around the perimeter of the frame to meet the "S" smoke rating is permissible in instances where smoke control is required.

1.3.1.2 Category B Positive Pressure Fire Door Construction

Conform all door openings to the applicable portions of NFPA 101 and NFPA 252. Incorporate field applied intumescent materials, applied by a licensed installer according to the manufacturers' instructions. Keep instructions on file. Additional gasketing may be required to meet the 'S' smoke rating. Submit Certificate for Intumescent Seals, Gasketing and Door Bottoms.

1.3.1.3 Labeling

Ensure all positive pressure door assemblies carry the fire label for the complete opening, clearly identifying the:

a. Manufacturer

b. Third party testing and certification agency

c. Fire door rating

d. Installation limitations

e. Compatible frame, hardware component ratings

f. Compatible lite or vision panel component ratings

g. Required building code information, including temperature and smoke rating

1.3.2 Testing

1.3.2.1 Sound Transmission Classification (STC)

Provide Test reports prepared by a nationally recognized, independent laboratory for Acoustical Tests, Air Infiltration Tests,Wind Loading Tests, and Water Leakage Tests indicating that the sound transmission classification (STC) of the proposed door, based on tests at 16 third-octave band frequencies from 125 to 4,000 hertz, is no less than the specified STC when tested in accordance with ASTM E 90, and that the door tested is hung in substantially the type of wall and frame as indicated and is fully operable with hardware and perimeter seals installed.

1.3.2.2 Positive Pressure

Provide Test reports, prepared by a nationally recognized, independent laboratory for Positive Pressure Tests, for all fire rated door assemblies, including Intumescent Seals,Gasketing, and Door Bottoms.

1.3.3 Guarantee

Provide written guarantee that each door delivered to the project is equal in construction, sound transmission classification (STC), and positive pressure test rating where applicable, with appropriate labeling and markings, to that of the sample door tested. Clearly state in written

guarantee that each door assembly, when installed in accordance with the manufacturer's printed instructions, has an in-place STC within 3 decibels of the specimen tested. Submit the following test data and Certificates with the written Guarantee:

Wind Loading Tests

Water Leakage Tests

Acoustical Tests

Air Infiltration Tests

Positive Pressure Tests

1.3.4 Testing and Performance

Provide assemblies that are identical to those tested at an independent acoustical laboratory qualified under the National Voluntary Laboratory Accreditation Program (NVLAP) by the National Institute for Science and Technology (NIST) in accordance with ASTM E 90 and ASTM E 413. On test reports include the laboratory name, test report number and date of test.

1.4 DELIVERY, HANDLING, AND STORAGE

Ship all doors in the manufacturer's undamaged individual cartons, securely bundled and wrapped with moisture-resistant covers and stored in accordance with the manufacturer's printed instructions in a dry, clean, and ventilated area.

Deliver and store wood doors in the building following the installation of concrete, terrazzo, plaster, or other wet materials, and only after the building has dried out and has a roof.

Maintain relative humidity in the building between 30 and 65 percent. Maintain the ambient temperature at 16 degrees C minimum at the time of installation of wood doors.

Make final adjustment of seals when temperatures and humidity conditions approximate the interior conditions that will exist when the building is occupied.

1.5 FIELD MEASUREMENTS

Filed verify all measurements prior to preparation of drawings and fabrication.

1.6 QUALITY ASSURANCE

Ensure work within this section is designed and furnished by one manufacturer, who has been engaged in the manufacture of Sound Retardant Hollow Metal Door systems for at least five (5) years prior to the start of this work.

Provide acoustic assemblies manufactured by a single source specializing in the production of this type work for a minimum of 5 years.

PART 2 PRODUCTS

2.1 GENERAL

Provide sound retardant door assemblies of the thickness, width, and height indicated, complete with perimeter seals, seal housings, gasketing, thresholds, door frames, and astragals as required to conform to the specified STC per ASTM E 90 and ASTM E 1289.

2.1.1 Components

Provide assemblies that are complete with metal frame, hollow metal door(s), sealing system, and Cam-lift hinges (when required).

2.2 STC RATING

Provide doors with an STC of at least 45 per the door schedule.

2.3 HOLLOW METAL SOUND RETARDANT DOORS

Conform to ASTM A1008/A1008M for door construction utilizing steel facing sheets. Conform stretcher level flatness to ASTM A568/A568M; not less than 1.52 millimeter thick; free from pitting, scale, and surface defects; separated by a core construction designed to meet the required STC; and tested and rated in accordance with ASTM E 90.

Provide doors that have flush seamless face sheets and vertical edges,with continuous welded and smooth joints. Provide edges that are flush or rabbeted as required for perimeter seals.

Provide hardware reinforcement that is steel drilled, tapped to template requirements and welded in place. Provide minimum thicknesses as follows:

Butts, 3.79 millimeter; locksets, 3.04 millimeter; surface-applied hardware, 1.90 millimeter.

Provide door surfaces that are visually flat and free from warp, waviness, and other surface irregularities and defects. Maximum allowable warp or twist-can not exceed 3 millimeter when measured with a 2100 millimeter straightedge along the diagonal and not exceed 1.5 millimeter when measured with a 2100 millimeter straightedge in the width or in any position along the length of the door.

Provide doors, including sound retardant type, to bear the UL label fire rating and the specified STC.

Shop paint exposed door surfaces, including surfaces that are galvanized.

Shop paint concealed exterior door surfaces except galvanized surfaces.

Thoroughly clean all mill scale, rust, oil, grease, dirt, and other foreign materials from surfaces before the application of the shop coat of paint.

After cleaning, provide galvanized surfaces free of paint in accordance with ASTM D 6386, Method A, B, C, or D.

Apply to clean prepared dry surfaces one shop coat of rust inhibitive metallic oxide or synthetic resin primer by brush, dipping, or other approved method to provide a continuous minimum dry film thickness (dft) of

0.023 millimeter.

2.3.1 Fabrication

Provide doors that are minimum 16 gauge, 4.445 centimeter thick with welded, seamless construction. No visible joints are permitted on the exposed faces or edges. Join door skins at vertical edges by continuous welds, ground and dressed smooth to provide a flush finish. Reinforce top and bottom with 16 gauge continuous inverted steel channels spot welded to both faces. Finish both top and bottom to provide a smooth flush condition. Bevel both vertical edges .3175 centimeter in 5.08 centimeter.

2.4 DOOR HARDWARE

Provide the following STC related hardware with the door; cam-lift hinges, perimeter seals, thresholds, hardware standoff brackets.

Include on Installation drawings a finish hardware schedule for each door and a hollow metal door frame schedule for each door indicating profile, dimensions, hardware reinforcement, and frame anchorage. Also indicate perimeter seals, door-bottom devices and other hardware items that are assembled in the shop.

Refer to Section 08 71 00 DOOR HARDWARE for remaining hardware requirements.

2.5 CAM LIFT HINGES

When required to achieve STC, manufacturer to furnish laboratory test data certifying hinges have been cycled a minimum of 1,000,000 while supporting a minimum door weight of 159 kg.

2.6 THRESHOLDS

Provide metal thresholds where indicated. Provide thresholds that are extruded aluminum, 6063-T5 alloy, mill finish, not less than 3 millimeter thick, with integral seal grooves formed to the indicated section.

Provide hardwood thresholds where indicated made of clear, all-heartwood, free of streaks, pin or worm holes, uniform in color, free of defects, finish sanded, and ready for job site transparent or paint finish.

PART 3 EXECUTION

3.1 PREPARATION

Upon receipt of material, thoroughly inspect all frames, doors and accessories.Verify quantities and tag numbers according to the packing list provided. Report all discrepancies, deficiencies and/or damages immediately to Contracting Officer.

3.2 SITE STORAGE

Store all materials on planks in a dry location. Store doors and frames vertically with minimum 12 mm airspace between. Store doors on the edge to eliminate any potential damage to the door bottom seal. Cover all material to protect from damage but in a manner to allow proper circulation.

Prior to installation check all doors and frames for correct size and swing. Verify that frames are plumb, square and aligned without twist in

accordance with tolerances published by NAAMM/HMMA and SDI.

3.3 FRAME INSTALLATION

Install frames plumb and true with not more than 0.8 millimeter deviation in vertical alignment in 2440 millimeter. Anchor to the wall in accordance with the printed instructions of the manufacturer. Grout frames solid with mortar in masonry, concrete, and plaster wall construction.

3.4 DOOR INSTALLATION

Install and adjust all doors, hardware, and seals in accordance with the approved drawings, hardware schedules, and the printed instructions of the door manufacturer.

Install and adjust perimeter seals to provide positive compression contact with the entire sealing surface with no gaps, openings, or breaks. Hinges or hardware which distort or pinch the perimeter seal during operation of the door will be rejected.

Install door bottom devices to seal the space between the door bottoms and the finished floor and the space between the seal and seal housing.

Field apply perimeter seal housings with mitered corners and with flush, aligned hairline joints.

Install components to manufacturer's written instructions. Coordinate with masonry wall construction for anchor placement. Set frames plumb, square, level and at correct elevation. Adjust operable parts for correct clearances and function. Install and adjust perimeter and bottom acoustic seals.

3.5 FIELD TESTING

Provide third party testing in accordance with ASTM E 336. Verify in writing that installed product performs no less than five (5) FSTC or NIC rating points below the specified laboratory STC rating. Examine, adjust, and retest any installation not meeting that criteria until compliance is obtained.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE

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 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	(2009) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.13	(2005) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.15	(2006) Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	(2008) Auxiliary Hardware
ANSI/BHMA A156.2	(2003) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	(2009) Thresholds
ANSI/BHMA A156.22	(2005) Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.3	(2008) Exit Devices
ANSI/BHMA A156.4	(2008) Door Controls - Closers
ANSI/BHMA A156.5	(2010) Auxiliary Locks and Associated Products
ANSI/BHMA A156.6	(2010) Architectural Door Trim
ANSI/BHMA A156.7	(2003; R 2009) Template Hinge Dimensions
ANSI/BHMA A156.8	(2010) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2009; TIA 09-1; TIA 09-2) Life Safety Code
NFPA 80	(2010; TIA 10-2) Standard for Fire Doors

and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8 (2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (2011) Building Materials Directory

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Hardware schedule; G

Keying system; G

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key BittingList

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.5.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and permanent removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1 All hinges will be manufactured to the standard template (ANSI 156.1) and supplied with phillips flat head machine or wood screws as appropriate. Finish screw head to match exposed surface of hinges.

Except as otherwise indicated; provide hinge pins as Follows;

1) Steel Hinges: Steel hinge pins.
2) Non ferrous hinges: Stainless Steel hinge pins.
3) Exterior and locking outswinging doors: Non removable pins.
4) Interior doors: Non rising pins.
5) Tips: Flush button and plugs, finished to match the leaf except where HT (hospital tip)is indicated.

Number of Hinges: Provide the number of hinges indicated but not less than 3 hinges for each door leaf up to 90" in height and one additional hinge for each 30" of height. One Center Pivot will be supplied on all door leaves up to 86" in height. Additional Center pivot will be provided for each 30" of height. Doors that are oversized will be supplied with additional hinges or pivots as indicated in the schedule attached.

Hinges will be a minimum of 4-1/2" in height and .134 thick. Width of hinge shall be sufficient to provide clearance for trim, applied door panels, frame moldings and door thickness.

Life of Building Warranty for all hinges. Full replacement for failure of mechanical operation or finish.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1. Provide mortise locks with roses not less than 178 by 57 mm diameter with a bushing at least 6 mm long. Provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install levers or knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.2.2 Auxiliary Locks

ANSI/BHMA A156.5, Grade 1.

2.3.2.3 Cypher/Combination Locks ASNI 156.2, D.O.D. 5220.22M

Heavy-duty, mechanical combination lockset with five pushbuttons, standard-sized levers, 20 mm 3/4 inch deadlocking latch, 70 mm 2 3/4 inch backset. Lock shall be operated by pressing buttons individually in the proper sequence. Inside lever shall always operate the latch. Provide a keyed cylinder on the interior to permit authorized service. Provide preparation for core to be supplied by USACE at exterior of doors.

Heavy-duty, mechanical combination deadbolt lockset with five pushbuttons, 25 mm 1inch deadbolt,70 mm 2 3/4 inch backset. Lock shall be operated by pressing buttons individually in the proper sequence. Inside turnpiece shall always operate the deadbolt. Provide a keyed cylinder to provide Key Over-ride by Management.

2.3.3 Exit Devices

ANSI/BHMA Al56.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars shall be provided in lieu of conventional crossbars and arms. Provide escutcheons, not less than 178 by 57mm, 7 by 2 1/4 inches.

2.3.4 Exit Locks With Alarm

ANSI/BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. Provide terminals for connection to remote indicating panel.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have seven pin, small format, interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Keying System

Provide a grand master keying system. Provide construction interchangeable cores. Temporary cores shall be a different key-section than permanent cores. Provide key cabinet as specified.

2.3.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.7.1 Knobs and Roses

Conform to the minimum test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 1.25 mm thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.89 mm thickness, and combined thickness of 1.78 mm, except for knob shanks, which are 1.52 mm thick.

2.3.7.2 Lever Handles

Provide lever handles where specified in paragraph entitled "Hardware Schedule" . Lever handles for exit devices shall meet the test requirements of ANSI/BHMA A156.l3 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 13mm (1/2 inch) of the door face. Lever design similar to DORMA LRA, SGT. LNL or BEST 15H.

2.3.7.3 Texture

Provide knurled or abrasive coated knobs or lever handles where specified in paragraph entitled "Hardware Schedule" for doors which are accessible to blind persons and which lead to dangerous areas.

2.3.8 Keys

Furnish a minimum of one file key, one duplicate key, and one working key for each keyed cylinder and for each master, grand master, in the key system. Furnish keys per schedule attached - Hardware Group "Miscellaneous". Stamp each key with appropriate key control symbol and "U.S. Property - Do not duplicate." Do not place room number on keys.

2.3.9 Door Bolts

ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.3.10 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4D and 4H. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule for installer to adjust. Closers shall be furnished preset for size 3" application. Provide manufacturer's 10 year warranty.

2.3.10.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's model number located to be visible after installation.

2.3.11 Overhead Holders

ANSI/BHMA A156.8.

2.3.12 Closer Holder-Release Devices

ANSI/BHMA A156.15.

2.3.13 Door Protection Plates

ANSI/BHMA A156.6.

2.3.13.1 Sizes of Armor, Mop and Kick Plates

50 mm less than door width for single doors; 25 mm one inch less than door width for pairs of doors. Provide 200 mm kick plates for flush doors. Provide 100 mm mop plates.

2.3.14 Edge Guards

ANSI/BHMA A156.6, stainless steel, of same height as armor plates. Apply to hinge stile unless shown in hardware schedule below.

2.3.15 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.16 Padlocks

ASTM F 883. Provide two (2) heavy duty padlocks for vehicle gates keyed to master key system.

2.3.17 Door Position Switches

Balanced Magnetic Switches - UL634 Level 2
Triple biased reeds, Remote test on Supervised Loop, Magnetic Field tamper, compensated for use on steel frames and U.L. listed. Surface sensor shall be equipped with a minimum of three (3) feet of armor cable extending from hard metal, non-corrosive housing.

2.3.18 Magnetic Locks

ANSI E08501/E08531 Surface applied magnetic locks. Holding requirements are to exceed the normal ANSI standard for Grade 1 in some applications. See listing below for applications and holding requirements. Provide mounting bracket with central splice area, all necessary filler bars, mounting screws and finished cover. Magnetic locks shall have built-in bond sensor to alert central station of failures to close and secure door fully.

Magnetic locks shall be mounted inside the secured area at all times. Contractor shall provide proper mounting brackets for each application as shown on floor plans. Push side mounting will be coordinated with other hardware to avoid interference with door operations. Contractor has option to mount push side closers in top jamb position on openings using surface magnetic locks.

Exterior Use: 1800lbs (818Kg.) holding force
Interior Use: 1200lbs (545Kg) holding force

2.3.19 Power Supplies

All electronically controlled or operated hardware will be by one manufacturer. Every component will have been tested and certified by U.L. and will bear a label showing its approval, rating and parameters. All power supplies will be listed as UL Class 2 Access Control, Fire, Burglary, Releasing Devices. Battery Back-Up shall be provided to comply with UL Standard 20ah and recharge. Output shall be as required by application.

2.3.20 Request to Exit Equipment

2.3.20.1 Push Button Switches

SPDT, MOMENTARY, illuminated push button switch, 2" (diagonal) flush square button, green, 10AMP contacts, with back box (single gang). Button will have instruction "PUSH TO EXIT" clearly printed in English with 3/8" letters on face of button.

2.3.20.2 Motion Detectors

PIR, 1 to 60second relock delay, surface mounted, adjustable U shape

coverage field(minimum 5ft x 6ft, maximum 10ft x 12ft), 12/24V DC input @26ma, 2 SPDT dry contacts (1 amp @ 30VDC).

2.3.20.3 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.3.21 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.22 Weather Stripping Gasketing

ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 2.19 by 10-5 cms per minute of air per square meter of door area when tested in accordance with ASTM E 283. Provide weather stripping with one of the following:

2.3.22.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.3.22.2 Interlocking Type

Zinc or bronze not less than 0.45 mm thick.

2.3.22.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.20 mm thick.

2.3.23 Lightproofing and Soundproofing Gasketing

ANSI/BHMA A156.22. Include adjustable doorstops at head and jambs and an automatic door bottom per set, both of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Furnish door bottoms with adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops mitered at corners. Provide the type and function designation where specified in paragraph entitled "Hardware Sets".

2.3.24 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, clear anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.24.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.24.2 Overhead Rain Drips

Approximately 38 mm high by 64 mm projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.25 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paintfinish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish.Exit devices shall be provided in BHMA 630 finish. Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

ANSI/BHMA A156.5, Type E8351 (150 hooks).

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 225 mm on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 25 mm on center and to

heads and jambs at 100 mm on center

3.1.2 Lightproofing and Soundproofing Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed by Architect and OIC. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

NOTES:

1. This project may contain doors that are oversized, non-standard thickness or have applied trims. See the plans and door schedules to determine hinge widths and clearance requirements.

2. Doors with glass lites and/or applied moldings will require spacers to allow fire exit device installation.

3. Thru-bolts are to be used only where specifically indicated. No bolts, heads or retainers are to show through door surface from applied hardware. All wood, hollow metal or specialty doors are to be reinforced

to allow for drilling and tapping of metal reinforcement or hardwood blocking that will hold wood screws.

4. Cylinders specified for use with exit devices are shown below. Because several different manufacturers may be substituted, contractor must confirm type and size of cylinders before ordering.

5. Openings requiring STC and/or Forced Entry and Bullet Resistance ratings may be furnished with hardware supplied by the door manufacturer. Contractor must coordinate cylinders and other materials required to provide a complete functioning opening.

Command & Control Center

HARDWARE GROUP # 1
Exit Only
Forced Entry-15 min/Bullet Resistant Level 8

ETH:

3ea Butts A5111 NRP 630
1ea Exit Device Type 1, Function 01 630
1ea Closer C02021 x PT4D x PT4H x TB 689
1ea Kickplates J102 x .050 x CSK x B3E x 10"high x 2LDW 630
1ea Floor Stop L02031 626
1ea Door Position Switch BMS UL634 Level 2 600
1ea Drip Cap R3Y005 628
1set Door Seals R3E165 628
1ea Door Bottom R0A535 628
1ea Threshold J36130 x ½"high x SS1/4-20MS/LA 628

HARDWARE GROUP # 2
Entrance & Exit
Forced Entry-15 min/Bullet resistant Level 8

ETH:

3ea Butts A5111 NRP 630
1ea Exit Device Type 1, Function 08 630
1ea Cylinders E09251/E09261 x E09241 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Closer C02021 x PT4D x PT4H x PT4G x TB 689
1ea Kickplate J102 x .050 x CSK x B3E x 200mm high x 50mm LDW 630
1ea Door Position Switch - BMS UL634 Level 2 600
1ea Drip Cap R3Y005 628
1set Door Seals R3E165 628
1ea Door Bottom R0A535 628
1ea Threshold J36130 x ½"high x SS1/4-20MS/LA 628

HARDWARE GROUP # 3
Exterior Mechanical Rooms
Forced Entry-15 min/Bullet Resistant Level 8

ETH:

6ea Butts A5112 NRP 630
2ea Flushbolts L04251 626

1ea StoreRm Lock F07/15** x KLO x Special LTC* 630
1ea Temp Core E09241 (Construction Cores) Grn
2ea O.H. Holder/Stop C08511 652
2ea Door Position Switch - BMS UL634 Level 2 600
1ea Drip Cap R3Y005 x 4"OOW 628
1set Weather Strip R3A165 628
2ea Door Bottom R0A535 628
1ea Threshold J36130 x ¾"high x SS1/4-20MS/LA 628
*Note: Astragal on outside of active leaf by door mfg. Provide strike with special lip to center dimension to provide clearance without cutting astragal.
** Mortise Lock with Rigid lever and Deadbolt - similar to Dorma M9980 function.

HARDWARE GROUP # 4
Exterior Electrical Rooms
Forced Entry-15 min/Bullet Resistant Level 8

ETH:

6ea Butts A5112 NRP 630
2ea Flushbolts L04251 626
1ea Exit Device Type 8D, Function 03 630
1ea Cylinders E09251/E09261 x E09241 630
1ea Temp Core E09241 (Construction Cores) Grn
2ea O.H. Holder/Stop C08511 652
2ea Door Position Switch - BMS UL634 Level 2 600
1ea Drip Cap R3Y005 x 4"OOW 628
1set Weather Strip R3A165 628
2ea Door Bottom R0A535 628
1ea Threshold J36130 x ¾"high x SS1/4-20MS/LA 628
*Note: Astragal on outside of active leaf by door mfg. Provide strike with special lip to center dimension to provide clearance without cutting astragal.

HARDWARE GROUP # 5
Small Individual Offices

ETH:

3ea Butts A8133 652
1ea Office Lock F04 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Stop L02251/L02141 626
3ea Silencers Gray

HARDWARE GROUP # 6
Janitor Closet

ETH:

3ea Butts A8112 NRP 652
1ea StoreRm Lock F07 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Closer C02061 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 Xb3E x CSK x 200mm high x 50mm LDW 630

1ea Stop L02251/L02141 630
1ea Sill J32100 x ¼"high x SS1/4-20MS/LA 628
3ea Silencers Gray

HARDWARE GROUP # 7
Electrical/IT Interior Closets

ETH:

3ea Butts A8112 NRP 652
1ea StoreRm Lock F07 KLO 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Closer C02021 x PT4D x PT4H x TB 689
1ea Stop L02251/L02141 630
1ea Sill J32100 x ¼"high x SS1/4-20MS/LA 628
3ea Silencers Gray

HARDWARE GROUP # 8
Small Closets off Corridors

ETH:

3ea Butts 8133 NRP 652
1ea StoreRm Lock F07 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Wall/Floor Stop L02251/L02141 630
3ea Silencers Gray

HARDWARE GROUP # 9
Passage Corridor to Corridor

ETH:

3ea Butts A8112 652
1ea Passage Set F01 630
1ea Closer C02011/C02021 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x B3E x CSK x 200mm high x 50mm LDW 630
1ea Door Position Switch - BMS UL634 Level 2 600
1ea Stop L02251/L02141 630
3ea Silencers Gray

HARDWARE GROUP # 10
Individual Toilets off Public Corridors or Spaces

ETH:

3ea Butts A8112 652
1ea Privacy Lock F19 630
1ea Closer C02011/C02021 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x B3E x CSK x 200mm high x 50mm LDW 630
1ea Door Position Switch - BMS UL634 Level 2 600
1ea Stop L02251/L02141 630
3ea Silencers Gray

HARDWARE GROUP # 11
Gang Toilets, Breakrooms

ETH:

3ea Butts A5111 630
1ea Pushplate J3018x16 630
1ea Pull J402 x ¾"diameter x 8"CTC x TB* 630
1ea Closer C02011 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x B3E x CSK x 200mm high x 50mm LDW 630
1ea Mop Plate J103 x .050 x B3E x CSK x 100mm high x 25mm LDW 630
1ea Stop L02251/L02141 630
3ea Silencers Gray
Note: Sill by others.
" Install pull with TB's. Cover TB's with pushplate.

HARDWARE GROUP # 12
Passage/Exit Doors

ETH:

3ea Butts A5113 652
1ea Fire Exit Device Type 1, Function 08A 630
1ea Closer C02011/C02021 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x B3E x CSK x 200mm high x 50mm LDW 630
1ea Wall Stop L02251 630
1ea Door Position Switch - BMS UL634 Level 2 600
1set Smoke Seal 9090 TAN Nat'l Guard
1ea Sill J32100 x ½"high x SS1/4-20MS/LA 628

HARDWARE GROUP # 13

ETH:

3ea Butts A8113 NRP 652
1ea Butt A8113 ETW-6 652
1ea Elec. Lock F07-ELEC - 24VDC- FSE* - RQE 630
1ea Temp Core E09241 (Construction Cores) Grn
1ea Combination Lock CDX-09 626 Kaba-Mas
1ea Closer C02011/C02021 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x B3E x CSK x 200mm high x 50mm LDW 630
1ea Power Supply 120VAC/1AMP input/24VDC 1AMP output
Regulated, modulated power, UL Class 2 Access Control
With Battery Back-up 9amp hrs, in NEMA Type 1 box 600
1ea Junction Box NEMA Type 1 (10x10x5) w/20pt terminal strip 600
1ea Key Switch MOM DPDT rated 6amps @ 120VAC 630
1ea Cylinder E09251/E09241 630
1ea Wiring Diagram WD-13 -
1ea Door Position Switch - BMS UL634 Level 2 600
1set Sound Seals R3C264 628
1ea Auto Door Bottom R0C345 628
1ea Sill J32100 x1/4"high x SS1/4-20MS/LA 628
" Fail Secure, power on releases outside lever and allows latch to be retracted by depressing lever.
" RQE = Request to Exit switch, installed internally, for any mechanical locking or exiting mechanism.
" ETW-6 Thru-Wire Hinge with 2ea 20GA wires and 4ea 30GA wires

HARDWARE GROUP # 14

ETH:

2ea Butts A8111 NRP 652
1ea Butt A8111 ETW-6 652
1ea Exit Device Type 1, Function XX, Combination *, ELR, RQE 630
1ea Closer C02011/C02021 x PT4D x PT4H x TB 689
1ea Kickplate J102 x .050 x CSK x 3BE x 200mm high x 50mm LDW 630
1ea Power Supply * 600
1ea Junction Box NEMA Type 1 (10x10x5) w/20pt terminal strip 600
1ea Door Position Switch - BMS UL634 Level 2 600
1ea Wiring Diagram WD-14 -
1set Sound Seals R3C264 628
1ea Auto Door Bottom R0C345 628
1ea Sill J32100 x1/4"high x SS1/4-20MS/LA 628
Note: Card Reader, relays, cable, conduit, connectors and terminations by Security Contractor.
Remote operation from room .
" ETW-6 Thru-Wire Hinge with 2ea 20GA wires and 4ea 30GA wires
" ELR = Electric Latch Retraction
" RQE = Request to Exit switch, installed internally, for any mechanical locking or exiting mechanism.
" Power Supply for Exit Device, as required by E.D. manufacturer.
" Combination Dial, Deadbolt, Exit device (e.g. CD-X09 x 1000 by KABA-MAS)

HARDWARE GROUP # Misc.

PROVIDE THE FOLLOWING:

1ea Key Cabinet (see para. #
10ea Const. Master Keys
** Cut keys: GMK, MK's, and 3 keys each cyl.
15ea Extra permanent cores keyed to owner's directions.
1ea Written warranty for each, Lock & cylinders, closers and exit devices.
See Para. .
1set Catalog cuts and Parts Manuals for Locks, Closers and Exit Devices.
4hrs Jobsite instruction, inspection and consultations.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

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)

ANSI/AISC 341	(2005; Suppl No. 1 2005) Seismic Provisions for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2010) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2010) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(2009a) Nonstructural Steel Framing Members
ASTM C 754	(2009a) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(2003; R 2008e1) Installation of Interior Lathing and Furring
ASTM C 847	(2010a) Standard Specification for Metal Lath

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM ML/SFA 920	(1991) Metal Lathing and Furring

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Metal support systems; G

Submit for the erection of metal furring, and ceiling suspension

systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, Z180; aluminum coating ASTM A463/A463M, T1-75; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per ANSI/AISC 341 and UFC 3-310-04, "Seismic Design for Buildings" in seismic zones.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841, and ASTM C 847.

2.1.1.2 Non-loadbearing Wall Framing

NAAMM ML/SFA 920.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 645.

2.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.45 mm thickness, with 0.85 mm minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures. The ASTM certified third party testing statement for equivalent thicknesses shall not apply.

2.1.2.3 Z-Furring Channels with Wall Insulation

Not lighter than 0.5 mm thick galvanized steel, Z-shaped, with 32 mm and 19 mm flanges and 100 mm furring depth.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841, except as indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing

NAAMM ML/SFA 920, except provide framing members 400 mm o.c. unless indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 754, except provide framing members 400 mm o.c. unless indicated otherwise.

3.1.2.2 Non-loadbearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

3.1.2.3 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 600 mm o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 600 mm o.c.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 1.9 meters from a straight line;

c. Studs: 5 mm in 1.9 meters out of plumb, not cumulative; and

d. Face of framing members: 5 mm in 1.9 meters from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;

b. Plates and runners: 5 mm in 3.8 meters from a straight line;

c. Studs: 5 mm in 3.8 meters out of plumb, not cumulative; and

d. Face of framing members: 5 mm in 3.8 meters from a true plane.

-- End of Section --

SECTION 09 22 36

LATH

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 1063	(2008) Standard Practice for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
ASTM C 841	(2003; R 2008e1) Installation of Interior Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2011) Fire Resistance Directory

1.2 SUBMITTALS

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

SD-03 Product Data

Lath

Accessories

1.3 DELIVERY AND STORAGE

Deliver materials in the manufacturer's original unbroken packages or containers that are labeled plainly with the manufacturer's names and brands. Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling. Stack gypsum lath flat to avoid sagging or damage to edges, ends, or surfaces, and protect from exposure to direct sunlight.

PART 2 PRODUCTS

2.1 LATH

2.1.1 Metal Plastering Base (Lath)

Provide the type(s) and weight(s) required for the type and spacing of supports shown for the kind of plaster indicated and specified. Do not use rib lath for ceramic tile scratch coat. Use minimum 9 gauge (2.96 mm)

expanded lath at exterior walls.

2.1.1.1 For Portland Cement-Based Plaster (Stucco)

ASTM C 1063, self-furring diamond mesh metal lath weighing not less than 1.5 kilograms per square meter.

2.1.1.2 For Gypsum Plaster

ASTM C 841, self-furring diamond mesh metal lath weighing not less than 1.5 kilograms per square meter.

2.1.1.3 Paper Backing (Waterproofed Kraft Building Paper)

Provide metal plastering base with paper backing, for interior plastering at exterior wall plastering work.

2.1.2 Gypsum Lath

ASTM C 1063. Provide plain gypsum lath 9.53 mm thick.

2.1.3 Accessories

ASTM C 1063. Provide only galvanized steel accessories.

PART 3 EXECUTION

3.1 INSPECTION

Verify that framing, furring and accessories are securely attached and of proper sizes and spacing necessary to provide a suitable substrate to receive lath. Do not proceed with work until framing, furring and accessories are acceptable to the Contracting Officer for application of lath.

3.2 INSTALLATION

3.2.1 Lathing Materials and Accessories

Install in accordance with ASTM C 1063 for portland cement-based plaster work and ASTM C 841 for gypsum plaster work, except where indicated or specified otherwise herein.

3.2.1.1 Metal Plastering Base

Install where indicated on concrete and masonry plaster.

3.2.1.2 Metal Plaster Base with Paper Backing

Where used, lap joints to provide backing on backing and metal-on-metal. Lap backing not less than 25 mm. Lap backing so that water will flow to the exterior.

3.2.1.3 Gypsum Lath

Install where indicated.

3.2.1.4 Control (Expansion and Contraction) Joints

a. For portland cement-based plaster (ceilings and walls), install to create panels no larger than 10 square meters with no dimension exceeding 3150 mm.

b. For unrestrained gypsum plaster ceilings install to create panels no larger than 250 square meters with no dimension exceeding 15800 mm. For gypsum plaster walls, partitions and ceilings without perimeter relief install not more than 9000 mm on centers in either direction.

3.2.1.5 Plastering Beads

Install edge trim (casing bead) at the edges of plaster which abuts or adjoins an unplastered surface, on each surface at the internal angle formed by load bearing and non-load bearing walls and partitions abutting structural walls, columns, or floor-ceiling slabs. Fill voids formed in corners with sealant. Install corner beads at all vertical external corners of plaster walls.

3.2.2 Fire-Resistant Assemblies

Wherever fire-resistant construction is indicated, provide all materials and application methods, including types and spacing of fasteners, in accordance with the specifications contained in the UL Fire Resistance for the Design Number(s) indicated.

3.3 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC
Access Panels	24 by 36 inches	600 by 900 mm
	14 gage	1.8 mm
	16 gage	1.5 mm

-- End of Section --

SECTION 09 23 00

GYPSUM PLASTERING

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 11	(2010a) Standard Terminology Relating to Gypsum and Related Building Materials and Systems
ASTM C 206	(2003; R 2009) Standard Specification for Finishing Hydrated Lime
ASTM C 28/C 28M	(2010) Gypsum Plasters
ASTM C 35	(2001; R 2009) Inorganic Aggregates for Use in Gypsum Plaster
ASTM C 631	(2009) Bonding Compounds for Interior Gypsum Plastering
ASTM C 842	(2005e1; R 2010) Application of Interior Gypsum Plaster

1.2 SUBMITTALS

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

SD-04 Samples

Gypsum Plaster; G

Submit four 900 mm square panels of varying texture for the Contracting Officer's approval.

SD-08 Manufacturer's Instructions

ready-mix gypsum plaster

Submit manufacturer's printed mixing instructions for ready-mix plaster.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver manufactured materials in the manufacturers' original unbroken

packages or containers which are labeled plainly with the manufacturers' names and brands. Keep cementitious materials dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready for use.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Gypsum Plaster

Maintain an ambient temperature of not less than 13 degrees C continuously during plastering, and drying, and until occupancy heating conditions are established in the area. Maintain this temperature for not less than one week prior to the application of plaster. Provide regulated ventilation to prevent "sweatouts" or "dry-outs." When the building is exposed to hot dry winds or day-to-night temperature differentials of 10 degrees C or more, cover openings that are not glazed. Gypsum and related materials must conform to ASTM C 11. Provide permanent ventilation for spaces enclosed by suspended ceilings as indicated.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the specifications, standards, and requirements specified herein. Provide asbestos-free materials.

2.2 GYPSUM BASE COAT PLASTER

2.2.1 Gypsum Neat Plaster Base Coat

ASTM C 28/C 28M.

2.2.2 Gypsum Ready-Mixed Plaster Base Coat

ASTM C 28/C 28M.

2.3 GYPSUM FINISH COAT PLASTER

2.3.1 Gypsum Gaging Plaster Finish Coat

ASTM C 28/C 28M.

2.4 HYDRATED LIME

ASTM C 206, Type S.

2.5 AGGREGATES

2.5.1 Sand for Gypsum Base Coats

ASTM C 35.

Sand Gradation: Percentage retained by weight (plus or minus 2 percent) on each sieve.

Sieve Size			Max.	Min.
No.	4	4760 microns	0	0
No.	8	2380 microns	5	0

Sieve Size		Max.	Min.
No. 16	1190 microns	30	5
No. 30	590 microns	65	30
No. 50	300 microns	95	65
No. 100	150 microns	100	90

2.5.2 Sand for Gypsum Sand Float Finish

ASTM C 842.

Sand Gradation: Percentage retained by weight (plus or minus 2 percent) on each sieve.

Sieve Size		Max.	Min.
No. 20	850 microns	0	
No. 30	590 microns	0.5	
No. 100	150 microns	100	40
No. 200	75 microns	100	70

2.5.3 Lightweight Aggregates, Perlite or Vermiculite for Gypsum Base Coat

ASTM C 35.

2.5.4 Silica Sand or Perlite Fines

For use in lime-putty gypsum-gaged finish, aggregated white coat, must have the following gradation: 10 percent maximum retained on a No. 30 sieve (590 microns), 4 percent minimum and 70 percent maximum retained on a No. 100 sieve (150 microns), and 70 percent minimum and 100 percent maximum retained on No. 200 sieve (75 microns).

2.6 WATER

Use only potable water , free of mineral and organic substances that affect the hardening and durability of the plaster or stucco.

2.7 PROPORTIONING

Unless specified otherwise, materials are specified on a volume basis and must be measured in approved containers, to ensure that the specified proportions will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels (shovel count) is not be permitted. Prepare ready-mix gypsum plaster for use by the addition of water only.

2.7.1 Gypsum Base Coat Plaster

Use of sand or lightweight aggregate is optional in gypsum plaster basecoats.

2.7.1.1 Sand and Gypsum Plaster Base Coat

Mix scratch coat in the proportion of 45 kg of gypsum neat plaster to not more than 56 liter of damp loose sand; mix brown coat in the proportion of 45 kg of gypsum neat plaster to not more than 85 liter of damp loose sand; or scratch and brown coats may both be mixed in the proportion of 45 kg of gypsum neat plaster to not more than
70 liter of damp loose sand. Mix the basecoats for double-up work in the proportion of 45 kgof gypsum neat plaster to not more than 70 liter of damp

loose sand on gypsum lath and not more than 85 liter of damp loose sand on masonry.

2.7.1.2 Lightweight Aggregate and Gypsum Plaster Base Coat

Mix scratch coat in the proportion of 45 kg of gypsum neat plaster to not more than 70 liter of lightweight aggregate on gypsum lath, and not more than 85 liter of lightweight aggregate on masonry. Mix brown coat in the proportion of 45 kg of gypsum neat plaster to not more than 70 liter of lightweight aggregate on gypsum lath and not more than 85 liter of light weight aggregate on masonry. Where plaster thickness exceeds 25 mm, the aggregate proportion may be increased to 85 liter. Mix the basecoats in two-coat double-up work in the proportion of 45 kg of gypsum neat plaster to not more than 70 liter of lightweight aggregate on gypsum lath and not more than 85 liter of lightweight aggregate on masonry. Gypsum ready-mixed plaster with perlite aggregate may be provided in lieu of field-mixed lightweight aggregate and gypsum plaster, provided the specified proportion of aggregate to plaster does not exceed the proportion specified for field-mixed plaster.

2.7.1.3 Sand and High-Strength Gypsum Plaster Base Coat

Mix scratch coat in the proportion of 45 kg of high strength gypsum base coat plaster to not more than 56 liter of damp loose sand. Mix brown coat in the proportion of 45 kg of high strength gypsum basecoat plaster to not more than 85 liter of damp loose sand.

2.7.2 Gypsum Plaster Finish Coat

2.7.2.1 Lime-Putty

Prepare lime-putty in accordance with the printed directions of the manufacturer. Use putty following preparation or following a soaking period as recommended by the manufacturer.

2.7.2.2 Lime-Putty Gypsum-Gaged (White Coat)

Use over sand and gypsum plaster. Mix finish coat in the proportions of one part of gypsum gauging plaster to a volume of hydrated lime or lime putty.

This mix is approximately equivalent to one 45 kg bag of gypsum gauging plaster to:

a. Not more than four 22.5 kg bags of hydrated lime, or

b. Not more than 127 liter of lime putty, or

c. Not more than 132 liter of lime putty.

2.8 MIXING

2.8.1 Job-Mixed Materials

Mix materials in mechanical mixers except finish coats containing lime may be hand mixed. Mechanical mixers must be an approved type that accurately and uniformly controls the quantity of water. When mixing by hand, mix dry plaster aggregate to a uniform color in the mixing box, add water, and hoe the plaster immediately into the water and mix thoroughly to a proper consistency.

Water used for rinsing and cleaning containers and tools must not be used in mixing the materials.

Sand proportions must be damp and in loose condition. A volume of damp loose sand must contain a minimum of 36 kg of dry sand in 0.0283 cu m.

Mix the material while the mixer is in continuous operation in the following sequence:

a. Add maximum close to 90 percent of estimated quantity of water.

b. Add approximately one-half of the sand. If vermiculite or perlite is used, add all the aggregate.

c. Add cement and approved admixtures. Add lime prior to cement.

d. Add remainder of sand.

e. Mix with remainder of water as required. Mix until the mixture is uniform in color and consistency.

Avoid excessive mixing and agitation. Discard gypsum plaster which has begun to set before it is used; do not permit retempering. Do not use frozen, caked, or lumped materials. Empty mixers and mixing boxes after each batch is mixed, and keep free of old plaster.

2.8.2 Ready-Mixed Packaged Materials

Mix ready-mixed packaged gypsum plaster in accordance with manufacturer's printed instructions.

2.9 BONDING AGENT

ASTM C 631, interior application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces before application of gypsum plaster of projections, dust, loose particles, grease, bond breakers, and foreign matter . Do not apply plaster directly to surfaces (1) of masonry or concrete that have been coated with bituminous compound or other waterproofing agents, or (2) that have been painted or previously plastered. Before plaster work is started, wet masonry and concrete surfaces thoroughly with a fine fog spray of clean water to produce a uniformly moist condition. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before starting work. Do not apply gypsum plaster to surfaces containing frost.

3.2 WORKMANSHIP

3.2.1 Slump Tests

Apply Plaster by hand or machine. When a plastering machine is used, control the fluidity of gypsum plaster to have a slump of not more than 75 mm when tested using a 50 by 100 by 150 mm high slump cone. Subsequent to determining water content to meet the specified slump, do not add additional water to the mix. Conduct the slump test according to the

following procedure:

a. Place cone on level, dry, non-absorptive base plate.

b. While holding cone firmly against base plate, fill cone with plaster taken directly from the hose or nozzle of the plastering machine, tamping with metal rod during filling to release air bubbles.

c. Screed off plaster level with top of cone. Remove cone by lifting it straight up with a slow and smooth motion.

d. Place cone in a vertical position adjacent to freed plaster sample, using care not to shake or move base plate.

e. Lay a straightedge across top of cone, being careful not to shake or move cone. Measure slump in mm from the bottom edge of the straightedge to the top of the slumped plaster sample.

3.2.2 Application

Apply gypsum plaster in three coats, except as follows:

a. Gypsum plaster applied to masonry and gypsum lath using the two-coat double-up method.

Apply base coats with sufficient pressure and ensure plaster is sufficiently plastic to provide a strong bond to bases. Work base coats into screeds at intervals from 1500 to 2400 mm. Plaster must not be continuous across expansion and control joints occurring in walls, partitions, and ceilings. Finish work level, plumb, square, and true, within a tolerance of 3 mm in 2400 mm, without waves, cracks, blisters, pits, crazing, discoloration, projections, or other imperfections. Form plaster work carefully around angles and contours, and well-up to screeds. Take special care to prevent sagging and consequent dropping of applications. There must be no visible junction marks in finish coat where one day's work adjoins another.

3.2.3 Control And Expansion Joints

Check expansion, control joints and accessories to ensure unrestrained movement, metal lath not continuous behind the joints, and area between joints do not exceed 14 sq m.

3.2.4 Curing

3.2.4.1 Gypsum Plaster

Before the plaster has set, provide environmental controls to prevent the plaster from drying too fast. After the plaster has set, provide for rapid drying to develop high strength.

3.3 GYPSUM PLASTER WORK

ASTM C 842.

3.3.1 Gypsum Plaster Thickness Requirements

Plaster thicknesses are from face of metal lath plaster base (scratch coat)

or solid base surfaces.

a. Vertical Surfaces

Base Types	Base Coat	Finish Coat	Total Thickness
Metal Lath	13 mm	3 mm	16 mm
Masonry	13 mm	3 mm	16 mm
Concrete	13 mm	3 mm	16 mm
Other Bases	10 mm	3 mm	13 mm

b. Horizontal Surfaces. Total plaster thickness for metal lath plaster, masonry and concrete bases is 16 mm. Total thickness of plaster for horizontal concrete surfaces is 3 to 10 mm.

c. Where vertical and horizontal concrete surfaces require more than 16 mm and 10 mm, to produce required lines or surfaces, attach metal plaster base for plaster application as indicated.

3.3.2 Gypsum Plaster Basecoat Work

3.3.2.1 Gypsum Two-Coat System

Apply the first coat to cover the base with sufficient material and pressure to form a good bond on the wall or ceiling base. Before the first coat has set and without scratching or cracking the surface, apply a second coat (double back) of the same material proportion as the base coat to the screeds. Straighten to a true surface without application of water, and cross rake or scratch to receive the finish coat.

3.3.3 Gypsum Plaster Finish Coats

Moderately moisten or fog spray base coat of plaster that has become dry before finish coat is applied. Accelerate plaster, if necessary, to provide a setting time of not more than 4 hours from the time the plaster is mixed.

3.3.3.1 Lime-Putty and Gypsum-Gaged Finish Coats

Apply lime-putty gypsum-gaged finish white coat or aggregated white coat over the base coat, scratch in thoroughly, lay on well, double back, and fill out to a true, even surface. Allow the finish to dry a few minutes, then trowel well with water. Apply maximum pressure in order to compact the finish coat and provide a smooth finish free from blemishes and irregularities. Apply trowel finish coats of gypsum-gaged lime-putty over properly prepared base coats as thin as possible and 2 to 3 mm thick for conventional plaster system, except as necessary in spots to level out hollows in base coat.

3.4 PATCHING AND POINTING

Cut out and patch loose, cracked, damaged, or defective gypsum plaster. Patch must match existing work in texture, color and finish flush with previously applied gypsum plaster surfaces. Point work abutting or

adjoining finish work in a neat manner. Remove droppings or spatterings from surfaces. Leave clean and in a condition to receive paint or other finish. Remove protective covering from floors and other surfaces, and rubbish and debris from the interior and exterior of the building.

-- End of Section --

SECTION 09 24 23

STUCCO

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 A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1032	(2006) Standard Specification for Woven Wire Plaster Base
ASTM C 1063	(2008) Standard Practice for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 206	(2003; R 2009) Standard Specification for Finishing Hydrated Lime
ASTM C 841	(2003; R 2008e1) Installation of Interior Lathing and Furring
ASTM C 847	(2010a) Standard Specification for Metal Lath
ASTM C 897	(2005; R 2009) Aggregate for Job-Mixed Portland Cement-Based Plasters
ASTM C 926	(2006) Application of Portland Cement-Based Plaster
ASTM C 933	(2009) Welded Wire Lath
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lath

SD-03 Product Data

Proportions and Mixing

SD-04 Samples

Colored Stucco Finish Coat
Sample Panel

1.3 QUALITY ASSURANCE

Submit, if required, a SAMPLE PANEL as follows: One 300 mm square stucco panel showing finish texture and color and exposed reinforcement at the edges, one 300 mm square of reinforcement, and a 300 mm length of each accessory proposed, prior to proceeding with stucco work.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials to the site in the original packages and containers with labels intact and seals unbroken. Keep cementitious materials dry and stored off the ground, under cover and away from damp surfaces until ready to be used. Aggregate shall be covered to prevent the absorption or loss of moisture.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not apply stucco when the ambient temperature is 4 degrees C or lower, or when a drop in temperature below 4 degrees C is expected within 48 hours after application.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150/C 150M, gray portland cement Type II.

2.2 COLORED STUCCO FINISH COAT

Stucco finish coat shall be a mill mixed product using white portland cement and requiring only the addition of and mixing with water for application.

2.3 LIME

Lime shall conform to ASTM C 206, Type S.

2.4 SAND

Sand aggregate for job-mixed base coat and job-mixed finish coat stucco shall conform to ASTM C 897.

2.5 ACCESSORIES

Accessories shall be roll formed galvanized steel, or rigid polyvinyl chloride (PVC), except that cornerite and striplath shall be formed from steel sheets with manufacturer's standard galvanized coating. Vinyl members shall be in accordance with ASTM D 1784. Welded wire corner reinforcements shall be zinc coated, galvanized 1.4 mm steel wire conforming to ASTM A185/A185M. Furring shall include hangers, bolts, inserts, clips, fastenings, and attachments of number, size, and design to develop the full strength of the members.

2.6 METAL LATH

Metal lath shall conform to ASTM C 847, types and weights in accordance with the various spacing shown in ASTM C 841. Woven wire lath shall be a maximum 38 x 38 mm mesh wire of not less than 1.37 mm nominal diameter and shall conform to ASTM C 1032. Welded wire lath shall conform to ASTM C 933, with openings not to exceed 50 x 50 mm. Expanded metal or wire lath shall be fabricated in a manner to provide not less than 6 mm keying between wire and paper backing and keying shall be obtained by a uniform series of slots in a perforated face paper woven between the wires.

2.7 WATER

Provide clean, fresh, potable water, free from amounts of oils, acids, alkalis and organic matter that would be injurious to the stucco.

PART 3 EXECUTION

3.1 CONTROL JOINTS

Control joints shall be located as indicated on the drawings. Prefabricated control joint members shall be installed prior to the application of the stucco. Control joints shall be cleared of all stucco within the control area after stucco application and prior to final stucco set.

3.2 LATH

Install lath in accordance with ASTM C 841 or ASTM C 1063 except as otherwise specified. Metal and wire lath shall be applied straight, without buckles and with joints staggered. End laps of metal lath shall be not less than 25 mm. Horizontal joints shall be shiplapped. Lath shall be interrupted at all control joints. Submit drawings showing details of construction for reinforcement, furring, and grounds; including manufacturer's installation instructions for stucco materials, and locations where each mix and coating thickness will be used.

3.2.1 On Concrete and Masonry

Fasten lath every 200 mm vertically and every 400 mm horizontally. Where wood supports adjoin masonry or concrete in the same direction, provide casing bead, control joints, or reinforcement as indicated.

3.2.2 Over Metal Lintels and Flashings

Lath over metal lintels shall be extended vertically over the angles to a height of not less than 150 mm and horizontally across the underside of the lintels and shall be secured in an approved manner. Lath over metal

flashings shall lap the flashings not less than 50 mm and shall be extended vertically for a height of not less than 150 mm.

3.3 PREPARATION OF SURFACES

Preparation of surfaces for application of stucco to solid bases such as stone, masonry or concrete shall conform to the applicable requirements of ASTM C 926.

3.4 PROPORTIONS AND MIXING

Proportions and mixing for job-mixed base coat and finish coat shall conform to the applicable requirements of ASTM C 926. Mixing of mill-mixed finish coat shall be in accordance with the manufacturer's directions. Submit detailed description of the proposed job-mix proportions for base and finish coats; including identification of thickness of coats.

3.5 STUCCO APPLICATION

Stucco shall be applied in three coats to a thickness of not less than 25 mm as measured from the back plane of metal reinforcement, exclusive of ribs or dimples or from the face of solid backing or support, with or without metal reinforcement, to the finished stucco surface, including moderate texture variations. Stucco application shall conform to the applicable requirements of ASTM C 926 and the following:

3.5.1 Workmanship

Items or features of the work in connection with or adjoining the stucco shall be in place, plumb, straight, and true prior to beginning the stucco work. Metal and wire lath, where required, shall be in place and positioned to provide a good key at back of lath. Where lath is applied over copper, the copper shall be given a heavy coat of bituminous paint. Masonry surfaces to receive stucco shall be evenly dampened immediately prior to application of stucco. Each stucco coat shall be applied continuously in one general direction, without allowing mortar to dry at edges. Where it is impossible to work the full dimension of a wall surface in a continuous operation, jointing shall be made at a break, opening, or other natural division of the surface. Edges to be joined shall be dampened slightly to produce a smooth confluence. Exterior corners of stucco shall be slightly rounded. Stucco on soffit surfaces shall be pitched forward to form a drip.

3.5.2 Scratch Coat

Scratch coat shall be applied not less than 10 mm thick under sufficient pressure to form good keys and to completely embed the reinforcement. Before the scratch coat has set, it shall be lightly scratched in one direction and vertical surfaces shall be scratched in the horizontal direction only. The scratch coat shall be fog cured for a minimum of 72 hours.

3.5.3 Brown Coat

The scratch coat shall be dampened evenly to obtain uniform suction before the brown coat is applied. There shall be no visible water on the surface when the brown coat is applied. The brown coat shall be applied to the scratch coat with sufficient pressure to force the stucco into the scratches and shall be brought to a plumb, true, even plane with rod or

straightedge. When set sufficiently, the brown coat shall be uniformly floated with a dry float to promote densification of the coat and to provide a surface receptive to bonding of the finish coat. Brown coat shall be fog cured for a minimum of 72 hours.

3.5.4 Finish Coat

Surfaces of the brown coat shall be dampened not more than 1 hour before the finish coat is to be applied to a uniform wetness with no free-standing water on the surface. The finish coat shall have a trowel-textured finish and shall conform to the approved sample. The finish coat shall be fog cured for a minimum of 48 hours. Care shall be taken to prevent staining.

3.5.5 Surface Tolerance

When a 3 m straightedge is placed at any location on the finished surface of the stucco, excluding rough-textured finish, the surface shall not vary more than 3 mm from the straightedge.

3.6 CURING AND PROTECTION

Perform fog curing by applying a fine mist of water to the stucco. Care shall be exercised during fog curing to avoid erosion damage of the stucco surfaces. Do not use a solid stream of water. Frequency of fogging shall be not less than three times daily. Protect the stucco from the direct rays of the sun during severe drying conditions using canvas, cloth or other approved sheet material, when directed.

3.7 PATCHING AND POINTING

Loose, cracked, damaged or defective work shall be replaced or patched as directed. Patching shall match existing work in texture and color and shall be finished flush.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD

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 1002	(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C 1047	(2010a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1396/C 1396M	(2009a) Standard Specification for Gypsum Board
ASTM C 475/C 475M	(2002; R 2007) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(2004; R 2009e1) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 840	(2008) Application and Finishing of Gypsum Board
ASTM C 954	(2010) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

GYPSUM ASSOCIATION (GA)

GA 214	(2007) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water-Resistant Gypsum Backing Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer maintenance instructions

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 10 degrees C in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.4.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.
Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C 1396/C 1396M.

2.1.1.1 Regular

1200 mm wide, 12.7 mm thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C 1396/C 1396M

2.1.2.1 Regular

1200 mm wide, 12.7 mm thick, tapered edges.

2.1.3 Joint Treatment Materials

ASTM C 475/C 475M. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.3.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.3.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.3.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.3.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.3.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.4 Fasteners

2.1.4.1 Nails

ASTM C 514.

2.1.4.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

2.1.5 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.1.5.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted.

2.1.6 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.7 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab

bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.3.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- End of Section --

SECTION 09 30 00

CERAMIC TILE, QUARRY TILE, AND PAVER TILE

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 1026	(2010) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(2009) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(2007e1) 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 373	(1988; R 2006) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 648	(2004; R 2009) Breaking Strength of Ceramic Tile
ASTM D 2103	(2010) Standard Specification for Polyethylene Film and Sheeting
ASTM D 226/D 226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCA Hdbk	(2010) Handbook for Ceramic Tile Installation

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 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. For materials like Tile, submit Samples of sufficient size to show color range, pattern, type and joints.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Tile; G
Setting-Bed; G
Mortar, Grout, and Adhesive; G

SD-04 Samples

Tile; G
Grout; G

SD-07 Certificates

Tile; G
Mortar, Grout, and Adhesive; G

1.4 QUALITY ASSURANCE

Dimension and draw detail drawings at a minimum scale of 6 mm = 300 mm. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface.

1.5 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.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 10 degrees C and rising. Maintain temperature above 10 degrees C 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.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.8 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 41 kg and for floor tile of 113 kg 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 0.50 wet and dry in accordance with ASTM C 1028. Identify floor tile as Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Submit manufacturer's catalog data and preprinted installation and cleaning instructions plus a master grade certificate for tile.

2.1.1 Mosaic Tile

Furnish ceramic mosaic tile and trim shall be unglazed natural clay with cushion edges.

2.1.2 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free bright finish. Provide tile 150 by 150 mm.

2.2 WATER

Provide potable water.

2.3 MORTAR, GROUT, AND ADHESIVE

2.3.1 Latex-Portland Cement Mortar

TCA Hdbk.

2.3.2 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free latex-portland cement grout.

2.3.3 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified.

2.4 MEMBRANE MATERIALS

Conform to ASTM D 226/D 226M, Type 1 for 33 kg waterproofing membrane, asphalt-saturated building felt. Conform to ASTM D 2103 0.0102 for polyethylene film.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of the Raised Floor Manufacturer 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
Latex Portland Cement Mortar	3 mm in 2.4 meter	3.0 mm in 3 meter
Epoxy	3 mm in 2.4 meter	3.0 mm in 3 meter

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, method W201-11.

3.3.1 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Latex-Portland Cement to install tile in accordance with TCA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with "Raised Flooring Manufacturer's Recommendation".

3.4.1 Dry-Set and Latex-Portland Cement

Use 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.

3.4.2 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.5 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.5.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the

different materials.

3.5.2 Floors

Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 3 m each way in interior floor areas. Extend expansion joints through setting-beds and fill.

3.6 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.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS

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 A1008/A1008M	(2010) 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 A489	(2004e1) Standard Specification for Carbon Steel Lifting Eyes
ASTM A580/A580M	(2008) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2010) 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 834	(2010) Latex Sealants
ASTM E 1264	(2008e1) 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	(2010a) 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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, shall also be I-P products. Coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. The Contractor is responsible for all associated labor and materials and for the final assembly and performance of the specified work and products if I-P products are used. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

1.2.1 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of 35-39 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.

1.2.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-04 Samples

Acoustic Ceiling Tiles

SD-06 Test Reports

Ceiling Attenuation Class and Test

SD-07 Certificates

Acoustic Ceiling Tiles

1.4 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM 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. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

c. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System A

a. Type: III (non-asbestos mineral fiber with painted finish).

b. Flame Spread: Class A, 25 or less

c. Pattern: D.

d. Minimum NRC: 0.75 in all spaces when tested on mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 600 by 1200 mm

g. Edge detail: Square.

h. Finish: Factory-applied standard finish.

i. Minimum CAC: 40.

2.2 SUSPENSION SYSTEM

Provide standardexposed-grid standard width flange 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 23 mm. Provide inside and outside corner caps. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in UFC 3-310-04 and ASTM E 580/E 580M.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 1330 N ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 2.7 mm in diameter. ASTM A580/A580M, composition 302 or 304, condition annealed stainless steel, 2.7 mm in diameter.

2.3.2 Straps

Provide straps of 25 by 5 mm galvanized steel conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008Mwith an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.3.3 Rods

Provide 5 mm diameter threaded steel rods, zinc or cadmium coated.

2.3.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Eyebolt size must be a minimum 7 mm, zinc coated or cadmium plated.

2.3.5 Masonry Anchorage Devices

Comply with ASTM C 636/C 636M for anchorage devices for eyebolts.

2.4 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.5 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and

execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C 636/C 636M 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 150 mm from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips.

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.

3.2 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.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING

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 E 648	(2010e1) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1066	(2004e1; R 2010) Standard Specification for Vinyl Composition Floor Tile
ASTM F 1482	(2004; R 2009e1) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1861	(2008) Resilient Wall Base
ASTM F 710	(2008) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.2 SYSTEM DESCRIPTION

1.2.1 Fire Resistance Requirements

Provide a minimum average critical radiant flux of 0.22 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E 648.

1.3 SUBMITTALS

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

SD-03 Product Data

Adhesives
Vinyl Composition Tile
Wall Base

SD-08 Manufacturer's Instructions

Surface Preparation; G
Installation; G

SD-11 Closeout Submittals

Adhesives

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 with ambient air temperature maintained above 20 degrees C and below 30 degrees C, stacked according to manufacturer's recommendations. 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.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 20 degrees C and below 30 degrees C 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 13 degrees C 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.

1.8 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles installed. Provide extra wall base material composed of 6 m of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE TYPE A

Conform to ASTM F 1066 Class 2, (through pattern tile), Composition 1, asbestos-free, 600 mm square and 3.2 mm thick. Provide color and pattern uniformly distributed throughout the thickness of the tile.

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 raised flooring). Provide 100 mm high and a minimum 3.175 mm thick wall base. Provide job formed corners in matching height, shape, and color.

2.3 MOULDING

Provide tapered mouldings of vinyl or rubber clear anodized aluminum and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 6 mm. Provide bevel change in level between 6 and 13 mm with a slope no greater than 1:2.

2.4 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. 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.

2.5 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. Raised Floor System: As specified in Section 09 69 13 RIGID GRID ACCESS FLOORING.

2.6 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D 4078 for polish.

2.7 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

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. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

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 4.75 in 3048 mm. 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 PLACING VINYL COMPOSITION

Install tile flooring and accessories in accordance with raised floor manufacturer's recommendations. Prepare and apply adhesives in accordance with raised floor manufacturer's recommendations.

3.4 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.

3.5 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.

3.6 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.

3.7 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

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 TM 107	(2009) Colorfastness to Water
AATCC TM 134	(2006; E 2008) Electrostatic Propensity of Carpets
AATCC TM 16	(2004; E 2008) Colorfastness to Light
AATCC TM 165	(2008; E 2009) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method

ASTM INTERNATIONAL (ASTM)

ASTM D 3278	(1996; R 2004e1) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 5793	(2005) Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	(2010e1) Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM D 6859	(2005) Standard Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings
ASTM E 648	(2010e1) 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

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

16 CFR 1630	Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Installation; G
Moldings; G

SD-03 Product Data

Carpet; G
Moldings; G
Surface Preparation; G
Installation; G
Regulatory Requirements; G

SD-04 Samples

Carpet; G
Moldings; G

SD-06 Test Reports

Moisture and Alkalinity Tests; G

SD-07 Certificates

Carpet; G
Regulatory Requirements; G

SD-10 Operation and Maintenance Data

Carpet; G
Cleaning and Protection; G

1.3 QUALITY ASSURANCE

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 Regulatory Requirements and criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality.

1.4 DELIVERY, STORAGE, AND HANDLING

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,protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 16 degrees C for 2 days prior to installation. Do not store carpet near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 AMBIENT CONDITIONS

Maintain areas in which carpeting is to be installed at a temperature above 16 degrees C and below 32 degrees C 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 13 degrees C 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 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.

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.

a. Carpet: Two "Production Quality" samples 450 by 450 mm of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 300 mm long.

2.1.1 Modular Tile

Carpet shall comply with the following:

a. Carpet Construction: Bonded.

b. Type: Modular tile 600 by 600 mm square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

c. Pile Type: Level-loop.

d. Pile Fiber: Commercial 100 percent branded (federally registered trademark) nylon continuous filament.

e. Yarn Ply: Minimum 2.

f. Gauge or Pitch: Minimum 5 mm in accordance with ASTM D 5793.

g. Stitches or Rows/Wires: Minimum 10.33 per 25 mm.

h. Surface Pile Weight: Minimum .4 kg/square meter. This does not include weight of backings. Determine weight in accordance with ASTM D 5848.

i. Pile Thickness: Minimum 284 mm in accordance with ASTM D 6859.

j. Pile Density: Minimum 238.85 Kg/m3.

k. Dye Method: Solution dyed.

l. Backing Materials: Provide primary backing materials like synthetic material. 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 gluedown is needed.

2.2 PERFORMANCE REQUIREMENTS

a. Static Control: Provide static control to permanently regulate static buildup to less than 2.0 kV when tested at 20 percent relative humidity and 21 degrees C in accordance with AATCC TM 134.

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 of 0.22 watts per square centimeter 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 40 N average force for loop pile.

d. Colorfastness to Crocking: Comply dry and wet crocking with AATCC TM 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 TM 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 TM 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 440 N/m.

2.3 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Pressure sensitive, wet adhesive with a maximum VOC content of 50 grams/liter. Provide water resistant, mildew resistant, 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 60 degrees C in accordance with ASTM D 3278.

2.4 MOLDINGS

Install carpet moldings, either vinyl or aluminum, where floor covering material changes or carpet edge does not abut a vertical surface. Provide a hammered surface aluminum molding, pinless clamp-down type, designed for the type of carpet being installed. Provide natural color anodized finish. Provide a floor flange of a minimum 38 mm wide and face a minimum 16 mm wide.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with recommended instructions Raised Floor System as specified in Section 09 69 13 RIGID GRID ACCESS FLOOR. 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. Submit three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI 104. Submit 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.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting 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 Floorcovering Installer Association), or raised floor manufacturer's approved carpet 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 raised floor manufacturer's printed instructions. 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. Submit three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, and locations of edge molding. Submit installation drawings for: 1) Carpet Moldings diagramming the location of seams, edge moldings, and carpet direction for approval prior to installation.

3.4.1 Modular Tile Installation

Install modular tiles according to raised floor manufacturer's recommendations with release adhesive and snugly jointed together. Lay tiles in an alternating pattern with accessibility to the subfloor where required.

3.5 CLEANING AND PROTECTION

Submit three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. 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.

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 MAINTENANCE

3.6.1 Extra Materials

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of 2 percent of total square meters of each carpet type, pattern, and color.

-- End of Section --

SECTION 09 69 13

RIGID GRID ACCESS FLOORING

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 TM 134	(2006; E 2008) Electrostatic Propensity of Carpets
AATCC TM 16	(2004; E 2008) Colorfastness to Light

ASTM INTERNATIONAL (ASTM)

ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM E 648	(2010e1) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1066	(2004e1; R 2010) Standard Specification for Vinyl Composition Floor Tile

CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)

CISCA Access Floors	(2007) Recommended Test Procedures for Access Floors

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC300	(2009) Acceptance Criteria for Access Floors

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009; Errata First Printing) International Building Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99	(2005; TIA 05-1; TIA 05-2; TIA 05-3; Errata 05-1) Standard for Health Care

Facilities

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-C-490	(Rev E) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings

1.2 SYSTEM DESCRIPTION

Install access flooring at the location and elevation and in the arrangement shown on the drawings. The floor system shall be of the rigid grid stringer type, complete with all supplemental items, and be the standard product of a manufacturer specializing in the manufacture of access flooring systems.

a. Provide for self-alignment of floor panels, adjustable pedestals and readily removable floor panels covered as specified.

b. Lateral stability of floor support system shall be independent of panels. Provide a finished assembly that is rigid and free of vibration, noises, and rocking panels. Provide bolted stringer system with equipotential plane grounding.

c. Submit Certificates for the complete Access Flooring System including, but not limited to the following:

1) Compliance with ICC-ES AC300. Submit design data substantiating compliance with International Building Code Acceptance Criteria for Access Floors.

2) Load-bearing capabilities of pedestals, floor panels, and pedestal adhesive resisting force.

3) Supporting independent laboratory test reports. For panel loads, test results include concentrated loads at center of panel, panel edge midpoint, ultimate loads and uniform loads.

4) Floor electrical characteristics.

5) Material requirements

6) An elevated floor system free of defects in materials, fabrication, finish, and installation, that will remain so for a period of not less than 10 years after completion.

d. Warrant that, upon notification by the Government, defective work will be immediately replaced with new work at no additional cost to the Government.

e. Submit manufacturer's descriptive data, catalog cuts, and installation instructions. Include in the data information about any design and production techniques, total system including all accessories and finish coatings of under-floor components, procedures

and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Include cleaning and maintenance instructions. Systems which contain zinc electroplated anti-corrosion coatings are prohibited.

1.2.1 Allowable Tolerances

a. Floor Panel Flatness: Plus or minus 0.5 mm on diagonal on top of panel or underneath edge.

b. Floor Panel Length: Plus or minus 0.4 mm.

c. Floor Panel Squareness: Plus or minus 0.5 mm in panel length.

d. Finish Floor: Level within plus or minus 1.6 mm in 2 meters, and plus or minus 2.5 mm for entire floor.

1.2.2 Floor Panels

Conduct floor panel testing in accordance with CISCA Access Floors. When tested as specified, make all deflection and deformation measurements at the point of load application on the top surface of the panel. Floor panels shall be capable of supporting the following loads:

a. Concentrated load of 4450 5560 N on 645 square mm, at any point on panel, without a top-surface deflection more than 2.54 mm, and a permanent set not to exceed 0.25 mm in any of the specified tests.

b. Uniform live load of 11.97 kPa/square meter, without a top-surface deflection more than 1.5 mm, and a permanent set not to exceed 0.25 mm in any of the specified tests.

c. A rolling load of 3560 N applied through hard rubber surfaced wheel 152 mm diameter by 51 mm wide for 10,000 cycles over the same path. Permanent set at conclusion of test shall not exceed 1.0 mm.

d. A rolling load of 4450 N applied through a 75 mm diameter by 30 mm wide caster for 10 cycles over the same path, without developing a local overall surface deformation greater than 1 mm. In accordance with CISCA Access Floors, the permanent deformation limit under rolling load shall be satisfied in all of the specified tests.

e. An impact load of 670 N anywhere on the panel dropped from a height of 914 mm onto a 645 square mm area without failure of the system, according to CISCA Access Floors, Section 8 Drop Impact Load Test.

f. Ultimate Concentrated Load. Panels shall provide a safety factor of 3 times the specified concentrated load indicated above, when tested in accordance with CISCA Access Floors, Section 2 Ultimate Loading.

1.2.3 Stringers

Provide stringers capable of supporting a 1110 N concentrated load at midspan without permanent deformation in excess of 0.25 mm.

1.2.4 Pedestals

Pedestals shall be capable of supporting a 22.24 kN axial load without permanent deformation.

1.2.5 Bonding Strength of Pedestal Adhesive

Adhesive for anchoring pedestal bases shall have a bonding strength capable of resisting an overturning moment of 113 Nm when a force is applied to the top of the pedestal in any direction.

1.2.6 Bond Strength of Factory Installed Covering

Bond strength of floor covering shall be sufficient to permit handling of the panels by use of the panel lifting device, and to withstand moving caster loads up to 4.45 kN, without separation of the covering from the panel.

1.2.7 Seismic Calculations

1.2.7.1 Army Requirements

Submit calculations for special bracing to resist the effects of seismic or other forces in accordance with UFC 3-310-04, ICC IBC and ICC-ES AC300. Submit design calculations which demonstrate that the proposed floor system meets requirements for seismic loading. Certified copies of test reports may be submitted in lieu of calculations.

1.2.8 Grounding

Ground the access flooring system for safety hazard and static suppression. Provide positive contact between components for safe, continuous electrical grounding of entire floor system. Total system resistance from wearing surface of floor to building grounding electrode shall be within range of 0.2 to 2.0 megohms.

1.2.8.1 Joint Resistance

Electrical joint resistance between individual stringer and pedestal junctions shall be less than 0.1 milliohms. Electrical resistance between stringers and floor panels, as mounted in normal use, shall be less than 3 ohms.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Detailed Installation Drawings; G

SD-03 Product Data

Access Flooring System; G

SD-04 Samples

Floor Panels; G
Finish Flooring; G
Panel Support System; G
Accessories; G

SD-05 Design Data

Compliance with ICC-ES AC300; G
Seismic Calculations; G

SD-06 Test Reports

Factory Tests; G
Electrical Resistance; G
Field Tests; G

SD-07 Certificates

Access Flooring System; G

1.4 QUALITY ASSURANCE

Submit drawings showing location, details at floor perimeter, method of anchorage to structural subfloor, grounding, description of shop coating, installation height above structural floor, stairs, ramps, accessories and other details as specified. Take measurements from finished areas at site and submit Detailed Installation Drawings indicating:

a. Location of panels

b. Layout of supports, panels, and cutout locations

c. Stair, handrail, and ramp framing

d. Sizes and details of components

e. Lateral bracing

f. Typical cutout details

g. Gasketing

g. Floor finishes

h. Location of connection to building grounding electrode

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in undamaged condition, in original containers or packages, complete with accessories and instructions. Label packages with manufacturer's name and brand designations. Package materials covered by specific references bearing specification number, type and class as applicable.

1.5.2 Storage

Store all materials in original protective packaging in a safe, dry, and clean location. Store panels at temperatures between 4 and 32 degrees C , and between 20 and 70 percent humidity. Replace defective or damaged materials.

1.5.3 Handling

Materials shall be handled and protected in a manner to prevent damage during the entire construction period.

1.6 EXTRA MATERIALS

a. Provide four spare panels with identical finish flooring pedestals and stringers for each 100 square meters of access flooring and total of 3 linear meters of cut-out trim. Store extra stock in same manner and location as project materials.

b. Submit three separate samples of the specified finish flooring.

PART 2 PRODUCTS

2.1 FLOOR PANELS

2.1.1 Floor System Drawings And Planer Quality

a. Submit Fabrication Drawings for elevated floor systems consisting of fabrication and assembly details to be performed in the factory.

b. Indicate on Location Drawings exact location of pedestals, ventilation openings, cable cutouts, and the panel installation pattern.

c. Provide Detail Drawings showing details of the pedestals, pedestal-floor interlocks, floor panels, panel edging, floor openings, floor opening edging, floor registers, floor grilles, floor drains, cable cutout treatment, perimeter base, expansion joints, and peripheral support facilities.

d. Design and workmanship of the floor, as installed, shall be completely planar within plus or minus 1.5 mm in 3050 mm, 2.5 mm for the entire floor, and 0.7 mm across panel joints.

e. Floor-panel joint-width tolerances shall be 0.43 mm as measured with a feeler gage at any point in any joint when the panels are in the pressure contact required in final installation and as long as the air leakage requirements above are met.

f. Submit three complete samples of floor panels.

2.1.2 Panel Construction

a. Base access floor system on a 600 by 600 mm square module providing minimum of 600 mm clearance between structural floor and bottom of finished floor. Fabricate so accurate job cutting and fitting may be done using standard sizes for perimeters and around columns.

b. Do not expose metal on finished top surface of panels. Provide cutouts and cutout closures to accommodate utility systems and

equipment intercabling. Reinforce cutouts to meet design load requirements. Provide extra support pedestals at each corner of cutout for cutout panels that do not meet specified design load requirements.

c. Panel design shall provide for convenient panel removal for underfloor servicing and for openings for new equipment. Use panels of uniform dimensions within specified tolerances. Permanently mark panels to indicate load rating and model number..

d. Machine square floor panels to within plus or minus 0.13 mm with edge straightness plus or minus 0.064 mm. Tolerances apply to the panel before the plastic edging is applied.

2.1.2.1 Metal-Clad Cementitious Fill (Composite Panels)

a. Provide composite panels of die-formed steel construction totally enclosing the panel, including the top surface. The void spaces between the top sheet and the formed steel bottom sheet shall be completely filled with an incombustible cementitious or concrete material. Seal cut edges in accordance with manufacturer's recommendations. Gravity held panels with bolted stringer understructure: Fasten end of each stringer and mid-point of each 1212 mm stringer positively to pedestal heads, using manufacturer's standard screws. Provide screws that are removable from top.

b. Grid supported panels shall be further tested by supporting them at two opposite edges and applying a 2225 newton load at the center of a panel selected; the panel shall be similarly tested while supported at the other two edges. Weld failure at any point under this loading is not acceptable. This additional test shall be applied to one panel per 46.45 square meter of floor in the system, but in no case less than two panels. When any weld fails, the number of panels designated by the Contracting Officer shall be similarly tested; replace those panels that have a weld failure at no cost to the Government.

2.1.3 Floor Covering

Surface floor panels with materials firmly bonded in place with waterproof adhesive. The electrical resistance shall remain stable over the life expectancy of the floor covering. Any anti-static agent used in the manufacturing process shall be an integral part of the material, not surface applied. Bolt heads or similar attachments shall not rise above the traffic surface.

2.1.3.1 High Pressure Laminate

Provide high pressure laminate surfacing conforming to ANSI/NEMA LD 3, Grade HW 120. Total system electrical resistance from the wearing surface of the floor to the ground connection shall be between 150,000 ohms and 20,000,000,000 ohms.

2.1.3.2 Vinyl Composition Tile

Vinyl composition tile surfacing shall be 3 mm thick conforming to ASTM F 1066, Type IV, Composition 1. Tiles may be approximately 300 mm square or may be the full size of the panel. Refer to Section 09 65 00 RESILIENT FLOORING.

2.1.3.3 Carpet Tile

Carpet surfacing shall be field installed using one full carpet square per panel. Carpet shall be nylon filament, loop pile, minimum 0.8 kg/square m, minimum density 4000, and without cushion. Conform color fastness to AATCC TM 16. Carpet shall conform to ASTM E 648 with a minimum average critical radiant flux of 0.25 watts per square centimeter. Static control shall be less than 2.0 kV at 20 percent relative humidity at 21 degrees C, when tested in accordance with AATCC TM 134. Refer to Section 09 68 00 CARPET.

2.1.4 Edge Strip

Edge panels with extruded vinyl edge strips secured in place with mechanical interlock or adhesive bond, or use replaceable type. Top of strip shall be approximately 3 mm wide, and flush with the floor surfacing. Metal edge strips exposed at finish floor surface will be rejected.

2.1.5 Accessories

Provide the manufacturer's standard registers, grilles, perforated panels, and plenum dividers type where indicated. Provide registers, grilles, and perforated panels designed to support the same static loads as floor panels without structural failure, and capable of delivering the air volumes indicated. Registers and perforated panels shall be 25 percent open area and equipped with adjustable dampers.

2.1.6 Resilient Base

Base shall be rubber or vinyl straight style (installed with carpet) and resilient flooring , 100 mm high and a minimum 3 mm thick. Furnish Job Formed corners.

2.1.7 Lifting Device

Furnish a minimum of two devices per building.

2.2 PANEL SUPPORT SYSTEM

Design support system to allow for 360 degree clearance in laying out cable and cutouts for service to machines and so that panel and stringer together take up maximum of 50 mm. Submit one sample of each panel type and suspension system proposed for use.

2.2.1 Pedestals

Provide pedestals made of steel or aluminum or a combination thereof. Ferrous materials shall have a factory-applied corrosion-resistant finish. Provide pedestal base plates with a minimum of 10,300 square mm of bearing surface and a minimum of 3 mm thickness. Pedestal shafts shall be threaded to permit height adjustment within a range of approximately 50 mm, to permit overall floor adjustment within plus or minus 2.5 mm of the required elevation, and to permit leveling of the finished floor surface within 1.56 mm in 3000 mm in all directions. Provide locking devices to positively lock the final pedestal vertical adjustments in place. Pedestal caps shall interlock with stringers to preclude tilting or rocking of the panels.

2.2.2 Stringers

Provide stringers of rolled steel or extruded aluminum, to interlock with the pedestal heads to prevent lateral movement. Provide stringers that can be added or removed after floor is in place.

2.3 FASCIA

Provide aluminum or steel fascia plates at open ends of floor, at sides of ramps and steps, and elsewhere as required to enclose the free area under the raised floor. Steel plates shall have a factory applied baked enamel finish. Finish on aluminum plates shall be standard with the floor system manufacturer. Fascia plates shall be reinforced on the back, and supported using the manufacturer's standard lateral bracing at maximum 1200 mm on center. Provide trim, angles, and fasteners as required.

2.4 STEPS AND RAMPS

Securely fasten steps and ramps to the access flooring system and to the structural floor. Include in the construction standard floor system components and custom components as required, and all supports, fasteners, and trim necessary for a finished installation. Step nosings, threshold strips, and floor bevel strips shall be cast or extruded aluminum with non-slip traffic surfaces. Submit certificate of compliance attesting that the installed access floor system meets specification requirements, including all special equipment loads and specific electrical and or cable requirements.

2.4.1 Steps

Height of risers shall not exceed 180 mm. Design steps to support a uniform load of 7.18 kPa. Surface treads with the manufacturer's standard non-slip floor finish.

2.5 RAILINGS

Provide railings of the double rail and post type at stairs only, fabricated of at least 33 mm round seamless aluminum tubing with a satin natural anodized finish. At steps and ramps, make the top rail a minimum of 900 mm high and parallel to the incline. Make the top rail 1050 mm high at open ends of the floor. Guardrails shall have intermediate rails. Space posts maximum of 1500 mm oc. Provide railings complete with anchorages, floor plates, and end caps. Electronically ground hand rails to raised floor system to prevent static build-up.

2.6 FACTORY TESTS

Factory test access flooring, using an independent laboratory, at the same position and maximum design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

2.6.1 Load Tests

Conduct floor panel, stringer, and pedestal testing in accordance with CISCA Access Floors.

2.6.2 Bond Strength of Covering

Support The test panel on pedestals and stringers as specified for the installed floor. Brace the supports as necessary to prevent sideways movement during the test. Impose a test load of 4.45 kN on the test assembly through a hard plastic caster 75 mm in diameter and 25 mmwide. Roll the caster completely across the center of the panel. The panel shall withstand 20 passes of the caster with no delamination or separation of the covering.

2.7 CUT OUTS

Provide cable cutouts finished with rigid polyvinylchloride or molded polypropylene edging to conform to the appearance level of the floor surface and to cover raw edges of the cutout panel. Extrusion shall be of a configuration to permit its effective and convenient use when new cable openings are required. Provide at least 7300 mm of additional extrusion for future use.

a. Provide non-metallic adapter for openings less than 100 mm wide. Secure adapter adhesively in cutout to preclude removal from panel. Provide at least two adapters per 10 square meter for future use.

b. Openings larger than 100 mm wide shall use rigid polyvinylchloride or molded polypropylene edging. Perform cutting of panels, including cutouts, outside of the building.

c. When size of cutout reduces the performance requirement of panel, provide intermediate stringers adjacent to cutouts.

2.8 EDGE CLOSURE

Provide 1.5 mm aluminum closure plate and extruded aluminum nosing at exposed edge of floor. Back up the closure plates with aluminum or steel framing braced diagonally, or anchor at bottom to continuous angle.

PART 3 EXECUTION

3.1 INSTALLATION

Install the floor system in accordance with the manufacturer's instructions and with the approved detail drawings. Open ends of the floor, where the floor system does not abut wall or other construction, shall have positive anchorage and rigid support. Maintain areas to receive access flooring between 4 and 32 degrees C, and between 20 and 70 percent humidity for 24 hours prior to and during installation.

3.1.1 Preparation for Installation

Clear of all debris the area in which the floor system is to be installed. Thoroughly clean structural floor surfaces and remove all dust. Install floor coatings, required for dust or vapor control, prior to installation of pedestals, only if the pedestal adhesive will not damage the coating. If the coating and adhesive are not compatible, apply the coating after the pedestals have been installed and the adhesive has cured.

3.1.2 Pedestals

Pedestals shall be accurately spaced, and set plumb and in true alignment.

Set base plates in full and firm contact with the structural floor, and secured to the structural floor with adhesive or steel expansion anchors.

3.1.3 Stringers

Interlock stringers with the pedestal caps to preclude lateral movement, spaced uniformly in parallel lines at the indicated elevation.

3.1.4 Auxiliary Framing

Provide auxiliary framing or pedestals around columns and other permanent construction, at sides of ramps, at open ends of the floor, and beneath panels that are substantially cut to accommodate utility systems. Use special framing for additional lateral support as shown on the approved detail drawings. Provide additional pedestals and stringers designed to specific heights and lengths to meet structural irregularities and design loads. Connect auxiliary framing to main framing.

3.1.5 Panels

Interlock panels with supports in a manner that will preclude lateral movement. Fasten perimeter panels, cutout panels, and panels adjoining columns, stairs, and ramps to the supporting components to form a rigid boundary for the interior panels. Floors shall be level within the specified tolerances. Cut edges of composite panels shall be coated with a silicone rubber sealant or with an adhesive recommended by the panel manufacturer. Secure extruded vinyl edging in place at all cut edges of all panel cut-outs to prevent abrasion of cables.

3.1.6 Resilient Base

Provide base at vertical wall intersections. Cracks and voids in walls and other vertical surfaces to receive base shall be filled with an approved filler. Apply the base after the floor system has been completely installed with adhesive, in accordance with the base manufacturer's recommendations.

3.1.7 Fascia Plates

Cover exposed floor ends and exposed openings of stairs with aluminum or steel closures.

3.1.8 Repair of Zinc Coating

Repair zinc coating that has been damaged, and cut edges of zinc-coated components and accessories, by the application of a galvanizing repair paint conforming to ASTM A780/A780M. Areas to be repaired shall be thoroughly cleaned prior to application of the paint.

3.2 FIELD TESTS

Submit certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

3.2.1 Acceptance Tests

Conduct acceptance tests after installation of floor system. Make at least one test for each 40 square meters of floor area. Conduct tests in

presence of Contracting Officer and representatives of manufacturer and installer.

3.2.2 Electrical Resistance

Conduct testing of electrical resistance, in the completed installation, in the presence of the Contracting Officer in accordance with NFPA 99, modified by placing one electrode on the center of the panel surface and connecting the other electrode to the metal flooring support. Take measurements at five or more locations. Each measurement shall be the average of five readings of 15 seconds duration at each location. During the tests, relative humidity shall be 45 to 55 percent and temperature set at 21 to 24 degrees C. Select panels used in the testing at random and include two panels most distant from the ground connection. Measure electrical resistance with instruments that are accurate within 2 percent and that have been calibrated within 60 days prior to the performance of the resistance tests. The metal-to-metal resistance from panel to supporting pedestal shall not exceed 10 ohms. The resistance between the wearing surface of the floor covering and the ground connection, as measured on the completed installation, shall be in accordance with paragraph FLOOR COVERING.

3.3 CLEANING AND PROTECTION

3.3.1 Cleaning

Free of all debris the space below the completed floor. Before any traffic or other work on the completed raised floor is started, clean the completed floor in accordance with the floor covering manufacturer's instructions. Cleaning of ferrous surfaces shall conform to FS TT-C-490.

3.3.2 Protection

Protect traffic areas of raised floor systems with a covering of building paper, fiberboard, or other suitable material to prevent damage to the surface. Cover cutouts with material of sufficient strength to support the loads to be encountered. Place plywood or similar material on the floor to serve as runways for installation of heavy equipment not in excess of design load capacity. Maintain protection until the raised floor system is accepted.

3.3.3 Surplus Material Removal

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work. Remove all installation equipment, surplus materials, and rubbish from the work site.

3.4 SEISMIC SPECIAL INSPECTION AND TESTING

Perform special inspections and testing for seismic-resisting systems and components in accordance with UFC 3-310-04 and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.5 OPERATION AND MAINTENANCE MANUALS

Submit maintenance instructions for proper care of the floor panel surface. When conductive flooring is specified, also submit maintenance instructions to identify special cleaning and maintenance requirements to maintain "conductivity" properties of the panel finish.

-- End of Section --

SECTION 09 83 13

ACOUSTICAL WALL TREATMENT

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 TM 16	(2004; E 2008) Colorfastness to Light

ASTM INTERNATIONAL (ASTM)

ASTM C 423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D 1117	(2001) Evaluating Nonwoven Fabrics
ASTM D 5034	(2009) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM E 84	(2010b) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Installation
Acoustical Wall Panels; G

SD-04 Samples

Acoustical Wall Panels; G

SD-07 Certificates

Acoustical Wall Panels

1.3 DELIVERY, STORAGE, AND HANDLING

Protect materials delivered and placed in storage from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

1.4 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 FABRIC COVERED ACOUSTICAL WALL PANELS

Provide acoustical wall panels consisting of prefinished, factory assembled, seamless fabric covered, fiber glass or mineral fiber core system as described below manufactured to the dimensions and configurations shown on the approved detail drawings; submit drawings showing plan locations, elevations and details of method of anchorage, location of doors and other openings, base detail and shape and thickness of materials. Perimeter edges shall be reinforced by either an aluminum frame or a formulated resin edge hardener. Submit manufacturer's descriptive data and catalog cuts; fabric and vinyl swatches, minimum 450 mm wide by 600 mm long 3 samples of each color range specified; and certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance. Wall panels shall conform to the following:

a. Panel Width: Panel width shall be as detailed.

b. Panel Height: Panel height shall be as detailed.

c. Thickness: Panel thickness shall be detailed.

d. Fabric Covering: Seamless non-woven, needle punched 100 percent polyester, minimum 0.034 kg/linear meter. Tear strength shall be minimum 110 N machine direction and minimum 178 N cross-machine direction in accordance with ASTM D 1117. Tensile strength shall be minimum 220 N machine direction and minimum 330 N cross-machine direction in accordance with ASTM D 5034. Fabric covering shall be stretched free of wrinkles and then bonded to the edges and back or bonded directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer. Light fastness (fadeometer) shall be approximately 40 hours in accordance with AATCC TM 16.

e. Fire rating for the complete composite system: Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E 84.

f. Substrate: Fiber glass or mineral fiber.

g. Noise Reduction Coefficient (NRC) Range: .75 ASTM C 423.

h. Edge Detail: Square edge.

i. Core Type: Standard acoustical core.

j. Mounting: Acoustical panels shall be mounted by manufacturer's

standard concealed spline.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

Walls shall be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Do not begin installation until all wet work, such as, plastering, painting, and concrete are completely dry.

3.2 INSTALLATION

Panel installation shall be by personnel familiar with and normally engaged in installation of acoustical wall panels. Apply panels in accordance with the manufacturer's installation instructions. Submit manufacturer's installation instructions and recommended cleaning instructions.

3.3 CLEANING

Following installation, dirty or stained panel surfaces shall be cleaned in accordance with manufacturer's instructions and left free from defects. Panels that are damaged, discolored, or improperly installed shall be removed and new panels provided as directed.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	(2005) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D 4263	(1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(2008) Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F 1869	(2010) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 107	(Oct 2009) Rust Inhibitive Primer (Water-Based)
MPI 139	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 3
MPI 153	(Oct 2009) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 4	(Oct 2009) Interior/Exterior Latex Block Filler
MPI 42	(Oct 2009) Latex Stucco and Masonry Textured Coating
MPI 50	(Oct 2009) Interior Latex Primer Sealer

MPI 52	(Oct 2009) Interior Latex, MPI Gloss Level 3
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
MPI 95	(Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01	(2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2004) Hand Tool Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC VIS 1	(2002; e 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(1970; Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

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

29 CFR 1910.1000	Air Contaminants

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Submit color stencil codes

SD-03 Product Data

Coating; G

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings; G

SD-08 Manufacturer's Instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:; G

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 125 by 175 mm and of sufficient size to show pattern repeat and texture.

1.4.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 2430 mm by 2430 mm mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual

substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Contracting Officer's Representative.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 3 degrees C above dew point;

b. Below 10 degrees C or over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.8.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

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 13 degrees C and 29 degrees C 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.

1.9 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure

prior to the installation of materials that adsorb VOCs.

1.10 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.11.1.1 Exterior Painting

Includes new surfaces of the buildings and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.11.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.11.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.11.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.11.4 Definitions and Abbreviations

1.11.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.11.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.11.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.11.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.11.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.11.4.7 EXT

MPI short term designation for an exterior coating system.

1.11.4.8 INT

MPI short term designation for an interior coating system.

1.11.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.11.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.11.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.11.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.11.4.14 Paint

See Coating definition.

1.11.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.11.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Water jetting to SSPC SP 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 /SSPC SP 12/NACE No.5 WJ-3 or SSPC SP 10/NACE No. 2/SSPC SP 12/NACE No.5 WJ-2.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to

photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 6386, Appendix X2, and remove by one of the methods described therein.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 APPLICATION

3.5.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of

different manufacturers shall not be mixed.

3.5.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.5.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 9: Exterior Stucco Paint Table
Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.8 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 13 mm high for piping and a minimum of 50 mm high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.9 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.10 PAINT TABLES

3.10.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. See Section 09 96 00 HIGH-PERFORMANCE COATINGS

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE
surfaces.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. See Section 09 96 00 HIGH-PERFORMANCE COATINGS

EXTERIOR GALVANIZED SURFACES

A. New Galvanized surfaces:

1. See Section 09 96 00 HIGH-PERFORMANCE COATINGS

DIVISION 9: EXTERIOR STUCCO PAINT TABLE

A. New stucco:

1. See Section 09 96 00 HIGH-PERFORMANCE COATINGS

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. On existing stucco, apply primer based on surface condition.

DIVISION 10: EXTERIOR CLOTH COVERINGS AND BITUMINOUS COATED SURFACES PAINT TABLE

A. Insulation and surfaces of insulation coverings (canvas, cloth, paper): (Interior and Exterior Applications)

1. See Section 09 96 00 HIGH-PERFORMANCE COATINGS

3.10.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing Concrete, vertical surfaces, not specified otherwise:

1. Latex
New; MPI INT 3.1A-G3 (Eggshell) / Existing; MPI RIN 3.1A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 100 microns

B. Concrete ceilings, uncoated:

1. Latex Aggregate
MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42

System DFT: Per Manufacturer

Texture - Fine. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.

DIVISION 3: INTERIOR CONCRETE PAINT TABLE
Topcoat: Coating to match adjacent surfaces.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

1. High Performance Architectural Latex
MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

System DFT: 275 microns

Fill all holes in masonry surface

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex
MPI INT 5.1R-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 139	MPI 139

System DFT: 125 microns

B. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex
MPI INT 5.4F-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 139	MPI 139

System DFT: 125 microns

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Plaster and Wallboard not otherwise specified:

1. Latex
New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 100 microns

2. High Performance Architectural Latex - High Traffic Areas
New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139

System DFT: 100 microns

B. New Plaster and Wallboard in toilets:

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

1. Waterborne Light Industrial Coating
   New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 153	MPI 153

   System DFT: 100 microns

-- End of Section --

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

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.

MASTER PAINTERS INSTITUTE (MPI)

MPI 77	(Oct 2009) Epoxy Gloss
MPI 80	Primer, Vinyl Wash
MPI 101	(Oct 2009) Epoxy Anti-Corrosive Metal Primer
MPI 116	(Oct 2009) Epoxy Block Filler
MPI ASM	(2004) Architectural Painting Specification Manual

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 7/NACE No.4	(2007) Brush-Off Blast Cleaning

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Submit Material, Equipment and Fixture List in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items including manufacturer's name and identification. Data shall include detailed analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Manufacturer's data concerning application, thinning, and average coverage per liter shall be included.

Epoxy Coatings

SD-04 Samples

Submit sample Color Chips in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-07 Certificates

Submit certificates for following items showing conformance with the referenced standards contained in this section.

Epoxy Coatings

1.3 DELIVERY, HANDLING AND STORAGE

Special coating materials must be delivered to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Special coating materials must be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Solvents, thinners, and equipment cleaners must be stored with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 7 degrees C.

Submit Material, Equipment and Fixture List consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 75 millimeter by 100 millimeter or manufacture pull-down of each finish color and gloss as scheduled.

1.4 FIELD TESTS

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

1.5 PROTECTIONS AND SAFETY PRECAUTIONS

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Building materials and equipment must be left clean and with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching them with water and placing in a covered metal container.

1.6 QUALITY ASSURANCE

Comply with Master Painters Institute (MPI) Standards indicated and listed

in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

PART 2 PRODUCTS

2.1 EPOXY COATINGS

2.1.1 General

Conform to MPI 116 for epoxy coatings and epoxy block filler, as modified.

Vehicle resins for finish coats must be based on a polyamide-cured, epoxy-resin material. Apply finish coats with a dry-film thickness of not less than 0.1 millimeter per coat. Finish color and gloss must be as indicated.

2.1.2 Concrete Surface Coatings

Apply a epoxy coating system in conformance with MPI 77 for vertical concrete surfaces. Prime coat must fill concrete surface pores with a total dry-film thickness of not less than 0.05 millimeter.

2.1.3 Masonry Surfaces Coatings

Apply a Epoxy Coating System in conformance with MPI 77. Block filler must fill surface pores with a total dry-film thickness of not less than 0.2 millimeter.

2.1.4 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces must be a prime coat and not less than two finish coats. Comply with MPI 101 for an epoxy zinc primer with a metallic-zinc pigment for the substrate to be coated and the end use of the coated surface. Resin solids and zinc pigment must not be less than 80 percent of the total weight of the coating material. Apply prime coat with a total dry-film thickness of not less than 0.1 millimeter. Provide an epoxy-based finished coat as specified.

2.1.5 Aluminum Surface Coatings

Apply an Epoxy Coating System in conformance with MPI 80 and MPI 77. Apply prime coat with a total dry-film thickness of not less than 0.1 millimeter.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.

3.1.1.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk Maximum Moisture Content of concrete is 12 percent. Moisture content must be measured with electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 10 350 to 27 580 kPa at 150 mm to 300 mm.

Comply with SSPC SP 7/NACE No.4 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

3.1.1.2 Clay Masonry Substrates

Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

Clean surfaces with pressurized water. Use pressure range of 690 to 4140 kPa.

3.1.1.3 Steel Substrates

Remove rust and loose mill scale. Clean using methods recommended in writing by coating manufacturer. Conform to SSPC SP 7/NACE No.4 (NACE No. 4) for blast cleaning.

3.1.1.4 Galvanized-Metal Substrates

Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.1.1.5 Aluminum Substrates

Remove surface oxidation.

3.1.1.6 Wood Substrates

Prep substrates by scraping and cleaning small, dry, seasoned knot. Sand surfaces smooth. Apply a thin coat of knot sealer before applying an interior latex-based wood primer. Prime edges, ends, faces, undersides, and back sides of wood. After priming, fill holes and crevices to the finished surface with putty or plastic wood filler. After finished surface is dry, smooth surface by sanding. For a finished product.

3.2 COATING MATERIAL PREPARATION

3.2.1 General

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for the particular material and coat to be applied. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker must be allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform

density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.2.2 Thinning

Thinning must be done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.2.3 Tinting

Prime and intermediate coats of paint must be a slightly different tint from the finish coat to facilitate identification of each coat. Tinting must be done by the coating manufacturer and clearly identified as to color and coat.

3.3 APPLICATION OF COATING MATERIALS

3.3.1 General

Do not perform exterior painting in damp or rainy weather. Interior painting must not be allowed until the building is enclosed and has thoroughly dried out. Do not allow painting below 10 degrees Cand above 35 degrees C. Painting application must be in accordance with the coating manufacturer's recommendations, and as specified.

Application of coatings must be done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings carefully with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Surfaces must be sanded and dusted between coatings, as required, to produce a surface free of visible defects. High gloss coatings and clear finishes must be lightly sanded between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Do not accept cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections. Remove defective coating applications and recoat as directed.

Coating lines such as wainscots must be sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, must receive a dry-film thickness not less than specified.

3.3.2 Brush Application

Brushes must be clean and the proper size and type for high-quality application of the specified coating materials. Slow-dry coatings must be brushed out. Quick-dry coatings must be brushed only enough to spread out evenly.

3.3.3 Roller Application

Roller covers must be clean and of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

Roller application must be done carefully and must be equivalent in all respects to the same coats applied by high-quality brush application.

3.3.4 Spray Application

Spray application equipment must be limited to airless-spray equipment and electrostatic-spray equipment. Equipment must be clean and operated by workmen skilled in high quality application of coating materials.

Spray application of coatings must be limited to finish coats on metal frame works, siding, decking, wire mesh, and other surfaces where hand work would be inferior. Sprayed coatings must be carefully applied and equivalent in all respects to the same coats applied by high quality brush application. Each spray coat must be permitted to cure before the succeeding coat is applied. Do not permit doubling back with application equipment, for the purpose of building up film thickness of two coats in one operation.

Surfaces adjacent to areas to be spray coated shall be covered to prevent damage from overspray, coating rebound, and spray drift.

3.4 ACCEPTANCE PROVISIONS

3.4.1 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

3.4.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Application equipment must be cleaned promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

-- End of Section --