APPENDIX A-1

TECHNICAL SPECIFICATIONS

APPENDIX A -1 INDEX
TECHNICAL SPECIFICATIONS
for
UP Provincial Response Company
Maydan Shahr, Wardak Province, Afghanistan

DIVISION 01 GENERAL REQUIREMENTS

Section	Title
01010	Scope of Work
01015	Technical Requirements
01040	Security
01060	Special Requirements
01060a	Project Sign
01060b	Custom Forms
01312	Quality Control System
01321	Network Analysis Schedule
01321a	Appendix to 01321
01335	Submittal Procedures for Site Adapt Projects
01335a	Attachments AED
01335b	Site Adapt Submittal Register
01355	Environmental Protection
01415	Metric Measurements
01451	Contractor Quality Control (with design)
01525	Safety and Occupational Health Requirements
01525a	Appendix to 01525
01770	Closeout Procedures
01780a	Closeout Submittals
01781	Operation and Maintenance Data

DIVISION 02 - EXISTING CONDITIONS

02 41 00	Demolition

DIVISION 03 - CONCRETE

03 30 00	Cast-In-Place Structural Concrete

DIVISION 04 - MASONRY

04 20 00	Masonry
04 43 00	Stone Masonry and Concrete Perimeter Wall
04 57 13	Stone Masonry Wood Stove

DIVISION 05 - METALS

05 12 00	Structural Steel
05 40 00	Cold-Formed Metal Framing

05 50 13 Metal: Miscellaneous and Fabrications

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00 Rough Carpentry

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 13 53 Elastomeric Sheet Waterproofing
07 21 13 Board Insulation
07 21 16 Mineral Fiber Blanket Insulation
07 41 13 Non-Structural Metal Roofing
07 60 00 Flashing and Sheet Metal
07 84 00 Firestopping
07 92 00 Joint Sealants

DIVISION 08 - OPENINGS

08 11 13 Steel Doors and Frames
08 14 00 Wood Doors
08 34 63 Detention Hollow Metal Frames, Doors, and Door Frames
08 52 00 Wood Windows
08 56 63 Detention and Security Windows
08 71 00 Door Hardware
08 81 00 Glazing

DIVISION 09 - FINISHES

09 22 37.00 10 Lathing and Plastering
09 24 23 Stucco
09 66 00 Terrazzo Tile
09 90 00 Paints and Coatings

DIVISION 10 - SPECIALTIES

10 28 13 Toilet and Shower Accessories

DIVISION 22 - PLUMBING

22 00 00 Plumbing, General Purpose
22 07 19 Plumbing Piping Insulation

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

23 00 00 Air Supply, Distribution, Ventilation, and Exhaust Systems

DIVISION 26 - ELECTRICAL

26 00 00.00 20 Basic Electrical Materials and Methods

26 05 48.00 10	Seismic Protection for Electrical Equipment
26 20 00	Interior Distribution System
26 28 01.00 10	Coordinated Power System Protection
26 32 15.00 10	Diesel-Generator Set Stationary 100-2500 KW, With Auxiliaries
26 32 33.00 10	Uninterruptible Power Supply (Ups) System Above 15 KVA Capacity
26 41 00.00 20	Lightning Protection System
26 51 00	Interior Lighting
26 56 00	Exterior Lighting

DIVISION 31 - EARTHWORK

31 00 00	Earthwork
31 05 19	Geotextile

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 16	Aggregate Base Course
32 15 00	Aggregate Surface Course
32 31 00.00 10	Chain Link Fences and Gates

DIVISION 33 - UTILITIES

33 11 00	Water Distribution
33 16 15	Water Storage Steel Tanks
33 20 00	Water Wells
33 30 00	Sanitary Sewers
33 40 01	Storm Drainage
33 56 10	Fuel Storage Tanks and Piping
33 71 02.00 10	Electrical Distribution System, Underground

DIVISION 34 - TRANSPORTATION

34 71 13.19	Vehicle Barriers

DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

43 21 39	Pumps: Water, Submersible Vertical Turbine and Hand Operated
43 32 76	Chlorine-Feeding Machines (Automatic, Semiautomatic and Manual)

END OF INDEX

SECTION 01010

SCOPE OF WORK

1. GENERAL

This project consists of the design and construction of site improvements and construction of facilities to support the Afghanistan National Police Provincial Response Company (PRC) Units in Ghaghara Village, South of Maydan Shadr City, Nirkh district, Wardak Province, Afghanistan. This project is defined as the management, design, material, labor, and equipment to design and construct and/or refurbish all utilities, roads, buildings, force protection measures, site security, de-mining activities, and other features as referenced herein. The work within this contract shall meet and be constructed in accordance with current U.S. design and International Building Codes (IBC), Life Safety Code (NFPA-101), Force Protection and security standards. A partial listing of references is included herein:

IBC, International Building Codes 2006

NFPA 101, Life Safety Code

UFC 4-010-01, DoD Minimum Anti-Terrorism Standards for Buildings.

1.1 ENGLISH LANGUAGE REQUIREMENT

All information shall be presented in English. The Contractor shall have a minimum of one English-speaking representative to communicate with the COR at all times when work is in progress.

1.2 SUBMITTALS

Submittals and a Submittal Register are required as specified in Section 01335 SUBMITTAL PROCEDURES of the Basic Contract.

1.3 SECURITY

Security is critical to construction in Afghanistan, especially on roads and remote areas away from Coalition Force bases. The risk/threat level for the area surrounding this project site is Moderate relative to the chance of attack, improvised explosive devices (IEDs), kidnapping, theft, and vandalism. The Contractor shall have an appropriate amount of security/protection to match the threat in the project area and along the supply routes. A detailed security plan in accordance with Section 01040 SECURITY shall be approved by the Government before construction notice to proceed.

1.4 CQM TRAINING REQUIREMENT

See Section 01451 paragraph CQM TRAINING REQUIREMENT for Contractor's Quality Control Manager training requirements.

The Contractor's quality control plan, as defined in USACE Guide Specification 01451 (or 01 45 04.00 10), entitled "Contractor Quality Control", must include "The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function." For the QC Manager, qualifications must include a certificate demonstrating completion of an approved CQM course.

1.5 ELECTRICAL WORKER QUALIFICATIONS

All electrical work shall be performed by Journeymen Electricians and supervised by one Lead Electrician. Apprentice Electricians are allowed to assist the Journeymen, but the ratio of Journeymen to Apprentices shall not exceed 1:3.

Lead Electrician

- Proof of Completion of an Electrical Safety Course AND
- Proof of Completion of an Electrical Code Class (NEC or BS7671) AND
- Graduate of an Approved Trade School AND
- 4000 hours of verifiable commercial/industrial electrical experience

Journeyman Electrician

- Proof of Completion of an Electrical Safety Course AND
- Proof of Completion of an Electrical Code Class (NEC or BS7671) AND
- Graduate of an Approved Trade School AND
- 2000 hours of verifiable commercial/industrial electrical experience

Apprentice Electrician

- Proof of Completion of an Electrical Safety Course AND
- Proof of Completion of an Electrical Code Class (NEC or BS7671)

The Lead electrician must be on site at all times during electrical installations and be capable of installing as well as directing the installation of all electrical work in compliance with the governing Code.

1.6 CONSTRUCTION PROJECT SIGN

The contactor shall fabricate and display at least one sign to identify the project site as an Islamic Republic of Afghanistan sponsored project. The sign shall meet or exceed the requirements provided in Section 01060 SPECIAL REQUIREMENTS. If the Text Group T6 (which is the Project Title taken from the Contract) does not make it clear to the public viewing the sign what the project purpose is, succinct wording shall be added to Text Group T2 to make this clear (for example, “Hospital Wastewater Treatment Facility Expansion” or “20 KM paved road” or other project summary), to be submitted and approved by the COR. Exact placement of the sign at the project site shall be coordinated with the COR.

2. LOCATION

The site is located in Nirkh district, Wardak Province, Afghanistan, as shown on attached drawings.

Corner 1	34.30231 N	68.85774 E
Corner 2	34.30104 N	68.85957 E
Corner 3	34.29996 N	68.85857 E
Corner 4	34.30123 N	68.85674 E

The Contractor is to verify the coordinates provided and submit to the COR for approval, confirmation of the accuracy of coordinates provided. The development and construction of the site is required to be within the License. The Contractor is to notify the COR should the development of the proposed site require an encroachment of the LFC boundary. The Contractor is to obtain the necessary LFC area for the access road connecting the proposed site development to an existing road. The submittal will include an exhibit illustrating the limits, boundaries, and coordinates representing the LFC area.

3. UNEXPLODED ORDNANCE (UXO)

3.1 UXO REMOVAL AND CLEARANCE

Contractor IS responsible for initial clearance and removal.

The Contractor shall search for, identify and clear all mines and unexploded ordnance (UXO) from the entire site. The Contractor may only provide clearance and removal services via UN Mine Action Center for Afghanistan (UNMACA) accredited entities, and clearance shall be accomplished to the anticipated foundation depth as indicated in the contract. If sub-surface construction activities are to be performed on this site the minimum clearance depth will be one meter. Sub-surface clearance for construction activities in excess of one meter as defined by the contract parameters will also be the responsibility of the Contractor. Clearance by definition is an investigation and clearance of all sub-surface metallic anomalies on the site. Clearance and removal may only be undertaken in accordance with International Mine Action Standards (IMAS), Afghanistan Mine Action Standards (AMAS), and applicable U.S. Army Corps of Engineer (USACE) Ordnance & Explosives (OE) safety standards. When mines and/or UXO's are identified, the Contractor shall place them in a location in accordance with IMAS/AMAS/USACE until destruction of the items can take place. Construction work shall not occur inside the safety exclusion zone based on the most probable munitions (MPM) expected on the site. Construction will not commence in any area that has not been cleared to the specified depth.

The Contractor shall provide a standard UXO and Demining safety work plan to the US Army Corps of Engineers UXO / Demining COR for review prior to commencement of all UXO clearance / demining activities on the project sites. Once the UXO/ Demining clearance has concluded, the Contractor shall provide the US Army Corps of Engineers UXO / Demining COR a clearance certificate for review and approval before any construction activities are to commence.

NOTE 1: The USACE does not need written clearance certificate approval from the UNMACA to approve the construction start activities. However, the Contractor is responsible for providing a copy of the clearance certificate to the UNMACA for entry into their country wide database. A final signed copy of the UNMACE certificate must then be provided to the USACE UXO and Demining COR.

It is the responsibility of the Contractor to be aware of the risk of encountering UXO/mines and to take all actions necessary to assure a safe work area to perform the requirements of this contract. The Contractor assumes the risk of any and all personal injury, property damage or other liability arising out of or resulting from any Contractor action taken hereunder. The Contractor and its subcontractors may not handle, work with, move, transport, render safe, or disarm any UXO/mine, unless they have appropriate accreditations under the IMAS/AMAS from the UNMACA.

If a UXO/mine is encountered after a UNMACA-approved clearance certificate is provided to the Government, UXO/mine disposal shall be handled in accordance with Section 01015, Technical Requirements.

NOTE 2: Point of Contact for UXO and Demining Safety Work Plan review and approval shall be directed to the US Army Corps of Engineers Demining Safety COR:

Mine Action Coordination Center of Afghanistan
Website: http://www.macca.org.af/
Email: flora.sutherland@macca.org.af
Address:
Phone:+93 (0) 700 295 207
Fax:+92-51 211 450

Mr. Mohammed Sediq Rashid, Head of Operations
Email: sediq.rashid@macca.org.af <mailto:Sediq@macca.org.af>
Phone: +93 (0) 700 295 207

Mr. Rafiullah Alkozai, Communications Office
Email: rafiullah.alkozai@macca.org.af

Phone: +93 (0) 707 306 803

UXO Safety/ Demining COR, USACE
tan.uxo.demining.safety@usace.army.mil, Roshan:079-778-6848 Comm:540-667-2127

4. SUMMARY OF WORK

4.1 CONTRACTOR REQUIREMENTS

The Contractor shall provide site adapt design and construction of standard building designs, the Campus Utility infrastructure, and Civil Infrastructure as specified herein:

The Contractor shall perform this work as a Site Adapt contract in accordance with the requirements stated herein and in Section 01015 Technical Requirements. The construction of the Standard Buildings listed below shall be done in strict accordance with the plans and specification furnished, with no changes made to any feature of work shown in these design drawings and specifications. All other Site Adapt work shall be the responsibility of the Contractor and submitted for review in accordance with Section 01335 of this Contract.

4.1.1 STANDARD DESIGNS - DRAWINGS AND SPECIFICATIONS

4.2 CONTRACTOR SHALL CONSTRUCT ALL FEATURES OF CONTRACT WORK (ARCHITECTURAL, STRUCTURAL, CIVIL, MECHANICAL, PLUMBING, ELECTRICAL, ECT…) IN COMPLETE ACCORDANCE WITH CONTRACT PLANS AND SPECIFICATIONS FURNISHED BY AED. CONTRACTOR SHALL SUBMIT COMPLETE DESIGN ANALYSIS, PLANS AND SPECIFICATIONS FOR ALL DESIGN SUBMITTAL STAGES REQUIRED BY THE CONTRACT. IF THE SITE INVESTIGATION AND GEOTECHNICAL REPORT INDICATE FOUNDATION DESIGN AS SHOWN IN THE CONTRACT PLANS IS INADEQUATE, ALL NECESSARY INFORMATION (DESIGN ANALYSIS, PLANS AND SPECIFICATIONS) SHALL BE SUBMITTED FOR REVIEW AND APPROVAL BY AED ENGINEERING. THE COR SHALL BE INFORMED OF THIS CHANGE TO COORDINATE A MODIFICATION. EVEN IF FOUNDATION DESIGN CHANGES ARE REQUIRED, ALL OTHER FEATURES OF WORK SHALL BE ACCOMPLISHED IN STRICT COMPLIANCE WITH THE DRAWINGS, DETAILS AND SPECIFICATIONS PROVIDED IN THE CONTRACT, UNLESS CHANGES ARE REQUESTED UNDER THE CHANGES CLAUSE. DESIGN SUBMITTAL CONTENT SHALL INCLUDE FIELD TESTING, LABORATORY TESTING, DESIGN ANALYSIS, AND PLANS AND SPECIFICATIONS FOR: GEOTECHNICAL REPORT; EXISTING TOPOGRAPHIC SURVEY; FINAL GRADING/DRAINAGE PLANS; COMPLETE WATER SUPPLY SYSTEM; COMPLETE WASTEWATER SYSTEM; GREASE AND/OR OIL-WATER SEPARATORS; ROAD AND SIDEWALK NETWORK; ELECTRICAL GENERATION AND DISTRIBUTION SYSTEM; AND ALL OTHER SITE WORK FEATURES NOT INCLUDED IN THE FURNISHED PLANS AND SPECIFICATIONS. SEE SECTION 01335 FOR MORE INFORMATION ON REQUIRED SUBMITTALS.STANDARD BUILDING DESIGNS **(DESIGN DRAWINGS AND SPECIFICATIONS PROVIDED):**

NAME/DESIGNATION	NUMBER OF UNITS
Administration Building Type 6	Base-1
Barracks Type 2	Base-1 Optional-1
Barracks Type 3	Base-1
DFAC Type 3	Base-1
Toilet/Shower/Ablution/Laundry	Base-1

Secure Storage	Base-1
Gate House	Base-1
Guard Shack	Base-1
Guard Tower	Base-6
POL	Base-1
Warehouse	Base-1
Trash Collection Point	Base-1
Well House	Base-1
Fuel Storage Canopy and Vehicle Refuel Point	Base-1

4.3 STANDARD NON-BUILDING DESIGNS (DESIGN DRAWINGS AND SPECIFICATIONS PROVIDED):

- Primary and Secondary Entry Control Points to include Canopy at Primary ECP
- Perimeter Security Wall
- Fencing and Gates
- Wash Rack

Contractor Design and Construction for Infrastructure Other Than Standard Electrical Distribution System):

- Water Supply, Water Storage/Treatment, and Distribution System
- Sanitary Sewer Collection and Treatment System
- Storm Water Collection And Management
- Entry Control Points (Primary and Secondary)
- Road Network, Sidewalks, and Parking Areas
- Electrical Power and Site Communication Infrastructure

The design and construction work shall include but not be limited to that described herein.

Site Improvement Design Work shall be executed in accordance with the requirements described in Section 01015, and the Specifications and Drawings. In case of question or ambiguity, the Contracting Officer (KO) shall make the final decision. The KO shall furnish the decision in writing if requested by the Contractor. Designs shall be approved by the Contracting Officer's Representative (COR) prior to the start of work. The Contractor shall verify all dimensions provided in the scope of work prior to the start of any construction.

4.4 GENERAL REQUIREMENTS FOR FACILITIES

Work shall be executed in accordance with the Technical Requirements in Section 01015 and in the drawings. All requirements set forth in this Section, but not included in the Technical Requirements and/or drawings, shall be considered as set forth in both and vice versa. In case of question or ambiguity, the Contracting Officer (KO) shall make the final decision. The KO shall furnish the decision in writing if requested by the Contractor. Site adaptation of the provided designs shall be approved by the Contracting Officer's Representative (COR) prior to the start of work. The Contractor shall verify all dimensions provided in the scope of work prior to the start of any construction.

The Contractor is encouraged to use Afghan labor and subcontractors to the maximum extent possible commensurate with technical, security or other requirements or necessary considerations. The intent of

this contract is also to use locally procured materials and labor to the maximum extent possible, but this does not allow the Contractor to make changes to the Government-provided drawings, specifications or design analysis.

The Site Adapt work shall include the preparation of design documents and the subsequent construction of the site improvements described within this Section, Section 01015, and the Government-furnished Drawings, with design adaptations to fit the actual site selected. The facilities required for each site shall include structures and all utilities as indicated in the Drawings and/or Specifications as provided. Site work and facilities may require design adaptations to meet site conditions, and these adaptations shall be designed and constructed in accordance with current U.S. and International Building Codes and standards and as described in these documents. The Contractor shall submit any changes to the Government-provided Drawings, Specifications and Design Analysis in accordance with Contract Section 01335, Paragraph “Variations.”

Any standard that can be determined to be substantially equivalent to the standards specified in this document may be used, but it is the Contractor’s responsibility to show the equivalency of the alternate standard. Reviewable documentation must be provided to the KO for approval prior to use. Equivalency documentation must be submitted in a timely manner so as not to affect the schedule of the project. No part of the time lost due to such actions shall be made the subject of claim for extension of time, excess costs, or damages by the Contractor. A partial listing of references is included within the Request for Proposal.

Work at individual projects sites consists of the construction of a BP Company compound in accordance with the contract documentation. The compound consists of an administration building, senior/high barracks, open bay barracks, dining facility, toilet/shower/ablution/laundry building, a warehouse building, a POL storage building, and a secure storage facility. It also includes force protection structures, electrical system, plumbing/sewage system, and water delivery system. The Contractor shall insure that all seismic requirements are met in the construction of the facilities.

All occupied buildings shall be located a minimum 25 m from the from the force protection wall as indicated in the Concept Plan drawings to the greatest extent possible. Occupied buildings include the administration building, senior/high barracks, open bay barracks, dining facility, and toilet/shower/ablution/laundry building.

The facilities and utility systems shall be designed with adequate capacity for the populations shown in the following matrix:

Compound Populations:

Unit	Senior	High	Middle	Ordinary	Total
Provincial Response Company – Base Population	-	6	19	75	100
Provincial Response Company – Optional Additional Personnel	-	-	-	75	175

Site assessments will be provided for all of the sites, but must be verified by the Contractor. The Contractor is responsible for surveying, grading and drainage, and de-mining activities for the entire site. The entire site is defined by the limits of the Rights of Entry (ROE) and the site assessment.

Development of the compound should utilize the most suitable land for construction based on 130 m by 134 m within the force protection wall as illustrated in the Concept Plan drawing. Site plans should be submitted that conform to this requirement and the requirements of the contract documents.

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

In general, this project consists of designing and constructing of the following sub paragraphs:

4.5 SEQUENCE OF WORK

After de-mining, but prior to the construction of any structures, the Contractor shall submit a well test plan, drill and test the water well, conduct well design activities, and submit all required information to AED for review and acceptance prior to installing any permanent well features (per AED Design Requirements document). Failure to follow this process may, at AED's discretion, result in the Contractor having to remove the well casing and screen, re-drill the well and reinstall the proper features per the approved design. It is acknowledged that water may not be available at the site despite Contractor good faith efforts to find it. The Contractor shall drill one well per Section 01015 in an attempt to find water. If water cannot be found the Contractor shall immediately notify the Contracting Officer's Representative (COR). Contractor must still furnish all other parts of the water distribution system as described in the specifications.

Dry wells must be de-commissioned in accordance with ASTM D 5299. The Contractor shall submit a written plan for de-commissioning wells.

4.6 PROGRAMATIC DESIGN CHARRETTE

The Contractor shall prepare a programmatic Master Site Plan that will be generally applied to all construction locations. The Master Site Plan shall include all locations of construction office/storage containers, lay-down and construction debris removal area. The development of the master plan will include participation in a charrette that will be conducted at the Corps of Engineers Area or Resident Office administering the contract. The charrette shall be scheduled by the Government to occur within ten calendar days of notice to proceed. The programmatic Master Site Plan shall be submitted to the Government no later than twenty days after Notice to Proceed. Site specific adaptations of the programmatic Master Site Plan shall be submitted to the Government according to the schedule provided above.

4.7 SITE SPECIFIC SURVEYS & SUBMITTALS

For each individual construction site, the Contractor shall perform a geotechnical investigation as defined in Section 01015, perform a topographic survey of the site; adapt the programmatic Master Site Plan to the conditions applicable for specific locations; prepare a complete grading and drainage plan with existing grades, proposed grades, and building finished floor elevations based on the technical requirements; prepare a landscaping plan; prepare a water supply, disinfection, and distribution layout plan; and prepare a wastewater collection, septic tank, and leach field layout plan. If there is a requirement for on-site demolition, the Contractor shall prepare and submit a demolition plan for that particular site. The Contractor shall not locate facilities in wadis or dry river beds. The finish floor elevation of all facilities and slabs shall be a minimum of 150 mm above the adjacent finished grade and the 10-year flood elevation. The Contractor shall provide drawings and details to describe any adaptations to the standard design that will be required for individual project sites as a site specific submittal as necessary. At a minimum, site specific submittals shall include: the geotechnical investigation report; drawings, details and calculations associated with well construction; drawings, details and calculations associated with the pre-engineered metal buildings; drawings, details, certifications and calculations associated with the elevated water tank Contract drawings; drawings and details associated with demolition; drawings, and details associated with site grading; drawings, details, and calculations associated with well pump, disinfection system, distribution system construction; and drawings, details and calculations associated with sanitary sewer and leach field construction.

4.8 DEMOLITION AND GRADING

Minor site demolition is required prior to construction of new work. Grading at the site is required and shall conform to requirements within references herein.

Native crushed stone 100 mm thick shall be placed around all buildings, from the building wall or building landscaping out 2,000 mm and all areas of anticipated foot or vehicle traffic to reduce erosion and to provide dust control. Contractor shall compact underlying sub-grade to a minimum 95 percent of the

laboratory maximum dry density as determined by ASTM D 1557, Modified Proctor test. Concrete walkways shall be installed between buildings and parking areas.

4.9 GEOTECHNICAL SOIL INVESTIGATION – SUBSURFACE EXPLORING & TESTING

Existing geotechnical information is not available at the project site. Any site-specific geotechnical data required to develop foundations, materials, earthwork, and other geotechnical related design and construction activities for this project shall be the Contractor's responsibility. Geotechnical investigation shall specifically address the possibility that the site is underlain with collapsible soils supported with the appropriate tests and analysis for this condition as identified in Section 01015 paragraph Collapsible Soils. Shall the geotechnical investigation identify collapsible soils at the project site, then the procedures for collapsible soils shall be followed according to the criteria outlined in that paragraph.

4.9.1 GEOTECHNICAL QUALIFICATIONS

A geotechnical engineer or geotechnical firm responsible to the Contractor shall develop all geotechnical engineering design parameters and shall be qualified by education in geotechnical engineering.

4.10 WATER SYSTEM

Design and construct a Potable Water System (PWS), to include a well, water well pump(s), protected in an enclosed water well house, a ***7000 gallon*** elevated water storage tank and an underground pipe distribution network system. The elevated water tower shall be constructed in strict conformance with the furnished Contract drawings and specifications. Design of the water tank shall be the responsibility of the Contractor. The water system shall be designed and constructed in accordance with the AED Design Requirements, latest version, and UFC 3-230-03A Water Supply which include the use of a capacity factor. Water demand required for fire fighting and for irrigation and landscaping needs shall not be included in design demand calculations. The water system shall be designed to accommodate the total facility compound population as specified in the Scope of Work and verified by the Contractor.

A manually operated, lever, hand pump shall be installed at the well head. The pump shall be used to supply water when there is no electricity.

4.10.1 WATER WELL OPTION

4.10.1.1 DEPTH OF WELL

In the instance water is not discovered from the well drilled to the depth required in section 01015, the Contractor shall continue drilling the well until satisfactory water source is obtained. Distance of well depth is not to exceed 300 meters.

4.11 SANITARY SEWER SYSTEM

The sanitary sewer collection and treatment system shall be designed and constructed by the Contractor. The sanitary sewer collection system shall consist of gravity sewer pipe network and accessories such as manholes, cleanouts, and building service connections.

The sanitary sewer system shall be designed to accommodate the total facility compound population as specified in the Scope of Work and verified by the Contractor, including use of the required Capacity Factor from UFC 3-240-09FA Domestic Water Treatment, Chapter 4.

System capacity shall be calculated based on a hydraulic waste load equivalent to 80 percent of the required daily demand based on (Population) x (Per Capita Demand) x (Capacity Factor) = *(0.80) x (175 personnel) x (190 L/capita/day) x (1.5 Capacity Factor)* = ***39,900 lpd***. The gravity sewer collection system shall connect to the sewage treatment system which shall be a septic tank absorption field effluent disposal system, facultative pond system or other low maintenance, cost effective system.

Geotechnical investigation of the proposed sewage treatment site is required and the Contractor shall design the sewage treatment system to be compatible with site and soil conditions.

At a minimum, design shall include the following:

(a) Site Survey. The Contractor shall conduct a topographic survey to determine existing site characteristics. The Contractor shall conduct a utility survey to determine the locations of any nearby water lines, wells, sanitary sewers, storm sewers and electrical lines.

(b) Percolation Testing. At proposed sites for holding ponds and the absorption field, the Contractor shall perform percolation tests in accordance with AED Design Requirements: Sanitary Sewer and Septic Systems. Percolation testing may be carried out with a shovel, posthole digger, solid auger or other appropriate digging instruments. Percolation tests shall be accomplished uniformly throughout the area where the absorption field is to be located. Percolation tests determine the acceptability of the site and serve as the basis of design for the liquid absorption.

(c) Sanitary system layout. The Contactor shall design a sanitary system layout following requirements of Section 01015 this contract. Pipe, fittings, and connections shall conform to the respective specifications and other requirements as listed in Contract Section 01015 and all of its referenced codes.

(d) Septic system design. The Contractor shall design a septic tank and absorption field system including all tank geometry, hydraulic loading, and inlet and outlet configurations, number of compartments and related site preparation and earthwork. Provide bollards at locations shown on drawings provided to protect the septic tank and absorption filed. Design will be per specifications provided in Section 01015.

Contractor shall furnish and install portable latrines units during construction in locations as required by Section 01015. Portable latrines shall be a mix of western and eastern style units. Mix shall be determined by the contracting officer.

Portable lavatories: Contractor shall furnish and install hand wash units in locations as required on attached drawings and within Section 01015. Hand wash units shall include four wash units. Each wash unit shall consist of a basin, hand soap dispenser, and towel dispenser.

4.12 STORM WATER COLLECTION AND MANAGEMENT SYSTEM

The storm water collection and management system shall be designed in accordance with Section 1015 paragraph 3.4.7.

4.13 SITE POWER, ELECTRICAL, DISTRIBUTION SYSTEM, AND FUEL STORAGE

Contractor shall design the site electrical system in accordance with NEC (NFPA 70) requirements. Contractor shall refer to Section 01015 for detail descriptions and requirements of the Systems. Major Electrical Systems are, but not limited to: (a) On-Site Power Plant, (b) Site Secondary Power Distribution System, and (c) Interior Secondary Power Distribution System. A bulk fuel storage tank is required for a 30-day supply of fuel and shall be filled with fuel upon completion of the contract.

4.13.1 ON-SITE POWER PLANT

Power Plant shall consist of one 320 kVA generator in accordance with the requirements indicated in Section 01015. Generator shall be provided inside “weather-proof” (IP54 or better) enclosure. Generator pad and overhead cover should be constructed in accordance with the provided contract Fuel Generator Canopy drawings.

4.13.2 SITE SECONDARY POWER DISTRIBUTION SYSTEM

Site Secondary Power Distribution System shall include installation of underground cables in direct buried, thick walled, Schedule 80 PVC conduit from the Power Plant to the individual facilities, except under traffic areas where the conduit shall concrete encased.

4.13.3 INTERIOR SECONDARY POWER DISTRIBUTION SYSTEM

Interior Secondary Power Distribution System, rated at 400/230V, 3 phase, 4 wire and 50 Hz. with wiring installed in surface mounted metal conduits, shall be provided in all facilities, including Guard Towers, Guard Shack, and Guard House.

4.13.4 GENERATOR FUEL STORAGE

The work shall include a factory fabricated tank and installation of the entire fuel storage and distribution system. Tanks shall be skid mounted and be provided with a concrete dike. The dike shall have enough capacity for the entire contents of the tank, plus 10 percent. Provide a molded neoprene isolation pad to isolate an above-ground tank from the concrete pad underneath. Steel tank supports specifically are prone to encounter premature rusting due to constant exposure to moisture and their incompatibility with concrete. Tank shall be designed and manufactured for horizontal installation. Tank shall be mounted on the tank manufacturer's standard support skid. Skid shall span the entire length of the tank and shall separate the tank from the reinforced concrete slab by a minimum of 200 mm. Indicate on the drawings the number and size of each tank man way required. Tanks of 3,780 to 45,430 L to capacity will be provided with 760 mm diameter man ways. Tanks 3,780 L and larger will be provided with a minimum of 1 tank man way to allow for internal tank access. Piping will not penetrate through access man ways. Tank shall be provided with a combination cleanout and gauge connection. Vent pipe sizing shall be not less than 32 mm nominal inside diameter. Vent shall be the rupture disc type calibrated to burst at 13.8 kPa pressure, and operate at 80 percent of burst setting. Tank shall be provided with an overfill alarm system. Tank shall be provided with 2 stick gauges graduated in m and mm. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored. Each storage tank shall be provided with an automatic analog reading gauge which is directly mounted to a tank's man way cover. Provide an in-line centrifugal pump as part of the day tank package for fuel transfer from the bulk storage tanks to the day tank. Day tanks shall provide sufficient fuel for four hours of generator operation without refill. Provide cathode protection for metal components. Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions. Piping shall be inspected, tested, and approved before buying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain toward the corresponding storage tank. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Below ground nonmetallic pipe shall be installed in accordance with pipe manufacturer's instructions. Belowground piping shall be laid with a minimum pitch of 25 mm per 6 m.

4.14 FORCE PROTECTION MEASURES

The Contractor shall construct force protection measures as detailed in the drawings which include Perimeter Security Walls, ECP Gates, Vehicle Barriers, Guard Shack, Gate House, and Guard Towers. Construct Perimeter Security Walls as indicated on the site plan from native stone with concrete core, as shown on the provided contract drawings. Install outriggers and single-strand concertina wire on top of the wall. The wall shall measure at least 2.4 m high from grade inside the compound. Interior grade shall be higher than exterior grade. Wall thickness shall be not less than 600 mm. Guard Towers shall be constructed at all site corners at an offset to allow visual observation along the outside face of the wall. Outrigger supporting arms shall be "Y" shaped with post securely embedded into the top of the wall. Posts shall conform to the IBC standard for Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded.

4.14.1 PERIMETER SECURITY WALL

Masonry or native stone walls with concrete core shall be constructed around the perimeter of the site. The height of the walls shall measure at least 2.4 m from the inside and outside grades. The wall shall be topped with barbed wire outriggers and single-coil concertina style razor wire. The ground grade shall slope away from the wall for at least 5 m and shall be kept a minimum of 2.4 m below the top of wall for a minimum distance of 10 m. The wall shall be designed to keep all pedestrian and truck traffic outside the compound from having a visual line of site into the compound.

4.14.2 ENTRY CONTROL POINTS (ECP'S)

The Primary and Secondary ECP's shall include a manually operated steel swing gate for vehicles and a separate steel swing gate for personnel. The Primary ECP shall also include one Guard Shack, one Gate House, an ECP Canopy, and various active and passive barriers as indicated in the attached Contract Concept Plan. The Primary ECP shall be laid out and constructed in accordance with details provided in the drawings and the ECP canopy shall be constructed in accordance with Entry Control Point Canopy drawings. Design vehicle for ECP entrance is a fuel delivery/septic tank truck typical for region of project site.

4.14.3 ECP GATES

Slide Gates shall be provided for vehicle access at the Primary and Secondary Entry Control point . A Personnel Gate shall be provided for personnel access.

4.14.4 GUARD SHACK

Construct two Guard Shacks in accordance with the provided contract Guard Shack drawings, one inside and one outside the compound at locations as indicated in the Concept Plan drawing.

4.14.5 GATE HOUSE

Construct one Gate House in accordance with the provided contract Gate House drawings inside the compound adjacent to the primary ECP gate, as indicated in the Concept Plan drawing.

4.14.6 GUARD TOWERS

Construct guard towers in accordance with the provided contract Guard Tower drawings at the corners of the compound. Guard towers shall be offset from force protection wall corner to allow sight down the outside face of the wall.

4.14.7 FENCING AND BARRICADES

Fencing shall consist of the types shown or described herein. Chain link fences, 2 m in height, shall be provided at locations shown and described herein. Double swinging gates shall be provided in fences to allow direct vehicular access. Gates shall include locking mechanisms that can be secured with a padlock to prevent unauthorized entry. Entire fences, including gates, shall be topped with triple strand barb wire.

4.14.8 PASSIVE BARRIERS

Passive Barriers shall consist of the types shown or described herein. Provide passive barriers at locations shown on the concept plan provided. Contractor shall Site Adapt the passive barriers to satisfy the project site.

4.14.9 GUARD TOWERS

Construct Guard Towers, in accordance with the provided contract Guard Tower drawings, at the corners of the compound. Guard towers shall be offset from force protection wall corner to allow sight down the outside face of the wall. Access ladders shall be constructed per OSHA Standards. Guard Towers shall be provided with general lighting and shall be fitted with one 360-degree omni-directional searchlight.

4.14.10 FENCING AND BARRICADES

Fencing shall consist of the types shown or described herein. Chain link fences, 2 m in height, shall be provided around both the water supply and power generation/fuel storage areas. Double swinging gates should be provided in both fences to allow direct vehicular access to the well, and to the generator. Gates should include locking mechanisms that can be secured with a padlock to prevent unauthorized entry. Entire fences, including gates, should be topped with triple strand barb wire.

4.15 ROAD NETWORK, SIDEWALK, AND PARKING

The Contractor shall design and construct the entire road and parking network. The roads shall be designed to carry traffic of a 40 metric-ton five-axle vehicle. A storm drainage system shall also be included. The road layout shall provide access to entry control points, parking lots, vehicle maintenance facilities, fuel points, generator yard, sewage septic tank, and the trash collection point. Provide parking areas inside the compound, for number of vehicles and size as indicated in the concept plan. Roads shall be designed per Section 01015, Technical Requirements. Roadways and sidewalks are required as shown on attached drawings and shall be designed and constructed based upon recommendations from geotechnical analysis as required herein.

Provide a network of sidewalks to connect the buildings as indicated on the Concept Plan drawing. Sidewalks shall be minimum 1.5 m in width.

The Contractor shall design and construct an aggregate parking area(s) to accommodate the following vehicle types and numbers by compound:

Vehicle Type	Design Criteria	BP Company (No. Vehicles)	Parking Space Size m x m
Pickup Truck	One space per 6 personnel	16	4 x 5.5
Visitor	N/A	4	4 x 5.5
POV	N/A	4	4 x 5.5
5-Ton Truck	N/A	5	4 x 11
TOTAL		24 Standard vehicles and 5 5-ton trucks	

4.16 MOTOR POOL WITH WASH RACK

The Contractor shall construct a Motor Poll with Wash Rack in accordance with the provided contract drawings. Quantity of spaces required in the motor pool is identified on the provided drawings. Contractor is responsible for locating (within the Motor Pool fenced area) and constructing the Wash Rack.

4.17 FUEL STORAGE CANOPY AND VEHICLE REFUEL POINT

The Contractor shall construct, in the location shown on the provided Concept plan drawing, a Fuel Storage Canopy and Vehicle Refuel Point in accordance with the provided contract drawings.

4.18 TRASH COLLECTION POINT

The Contractor shall construct, in a location convenient for easy removal, a Trash Collection Point in accordance with the provided contract drawings. It shall be located outside the compound walls.

4.19 ADMINISTRATION BUILDING

Construct one Administration Building in accordance with the provided contract Administration Building Type 6 (506GSM) drawings. Administration building shall be located near the primary ECP as indicated in the Concept Plan drawing. Provide two flagpoles outside the administration building as illustrated in the Concept Plan drawing.

4.20 SENIOR/HIGH BARRACKS

Construct one Senior/High Barracks building in accordance with the provided contract Barrack Building Type 3 (384GSM) drawings.

4.21 OPEN BAY BARRACKS

Construct one Open Bay Barracks building as part of the base bid contract, in accordance with the provided contract Barrack Building Type 2 (579GSM) drawings. Provide clotheslines between the barracks building and the toilet/shower/ablution laundry building, approximately 5 m in length, with 4 lines across spaced 410 mm apart and of sufficient strength to prevent sagging when all of the lines are loaded.

4.22 DINING FACILITY

Construct one Dining Facility in accordance with the provided contract Dining Facilities Building Type 3 (384GSM) drawings.

4.23 SECURE STORAGE

Construct one Secure Storage building in accordance with the provided contract Secure Storage drawings. Location on site shall be as indicated on the Concept Plan drawing with door opening facing toward the force protection wall away from all other buildings in the compound.

4.24 TOLIET/SHOWER/ABLUTION/LAUNDRY

Construct one Toilet/Shower/Ablution/Laundry (TSAL) building in accordance with provided contract Toilet/Shower/Ablution/Laundry drawings. TSAL shall be located adjacent to the open bay barracks as indicated in the Concept Plan drawing.

4.25 POL BUILDING

Construct one POL building in accordance with the provided contract POL Building drawings.

4.26 WAREHOUSE BUILDING

Construct one Warehouse building in accordance with the provided contract Warehouse Building drawings.

4.27 OPTIONAL BID ITEMS

4.27.1 OPEN BAY BARRACKS

Construct one Open Bay Barracks building in accordance with the Barrack Building Type 2 (579GSM) drawings, as illustrated in the Concept Plan as bid option 1. Barracks shall be located so the toilet/shower/ablution/laundry building is located between the two open bay barracks buildings. Provide clotheslines between the barracks building and the toilet/shower/ablution laundry building, approximately 5 m in length, with 4 lines across spaced 410 mm apart and of sufficient strength to prevent sagging when all of the lines are loaded.

5. COMPLETION OF WORK

See Section 00150 for performance schedule. Period of performance is defined as the number of calendar days from receipt of notice to proceed.

6. REFERENCES

Refer to Section 01015 for required references.

-- END OF SECTION --

SECTION 01015

TECHNICAL REQUIREMENTS – SITE ADAPT

1.0 GENERAL

1.1 COMPLIANCE

The Contractor's design and construction must comply with technical requirements contained herein. The designer shall have a minimum of 5 years experience with the design and construction of the same magnitude and complexity as required in this project. The Contractor shall provide design and construction using the best blend of cost, construction efficiency, system durability, ease of maintenance and environmental compatibility. This is a site adapt contract; final design drawings of all facilities are provided to the Contractor as part of the contract; site work and related work.

1.2 ASBESTOS CONTAINING MATERIALS

Asbestos containing material (ACM) shall 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.

1.3 SAFETY

1.3.1 UNEXPLODED ORDNANCE (UXO)

It is the responsibility of the Contractor to be aware of the risk of encountering UXO/mines and to take all actions necessary to assure a safe work area to perform the requirements of this contract. If during construction, the Contractor becomes aware of or encounters UXO/mines or potential UXO/mines, the Contractor shall immediately notify the COR, mitigate any delays to scheduled or unscheduled contract work, and clear/remove the UXO/mines. The Contractor may only provide clearance/removal services via UNMACA accredited entities. Clearance/removal may only be undertaken in accordance with IMAS/AMAS/USACE standards. The Contractor assumes the risk of any and all personal injury, property damage or other liability arising out of or resulting from any Contractor action taken hereunder. Scrap metal shall be the property of the Host Government. The scrap metal on site shall be moved to an area away from the site perimeter as directed by the Contracting Officer’s Representative and left for the Host Government to remove and salvage.

See Section 01010 Scope of Work paragraph UXO Removal and Clearance for Points of Contact for UXO/Demining Safety Work Plan review, to obtain a copy of the clearance certification and/or previous UXO/mine information.

1.3.2 UNEXPLODED ORDNANCE (UXO) SAFETY SUPPORT DURING CONSTRUCTION

It is the responsibility of the Contractor to be aware of the risk of encountering UXO and to take all actions necessary to assure a safe work area to perform the requirements of this contract. If after the entire site has been cleared of UXO/mines per the International Mine Action Standards (IMAS) and clearance is done to the anticipated foundation depth, the Contractor becomes aware of or encounters UXO or potential UXO during construction, the Contractor shall immediately stop work at the site of the encounter, move to a safe location, notify the COR and Demining Contractor/ Demining Sub-Contractor, and mitigate any delays to scheduled or unscheduled contract work. The Demining Contractor/ Demining Sub-Contractor shall remove and dispose of UXO’s per the International Mine Action Standards (IMAS).

These standards can be found at http://www.mineactionstandards.org. The Contractor assumes the risk of any and all personal injury, property damage or other liability, arising out of and resulting from any Contractor action hereunder. In these cases the Contractor shall be required to identify and dispose of the ordnance.

1.3.2.1 LIMITATION OF WORKING SPACE

The Contractor shall, except where required for service connections or other special reason(s), 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 shall take all practical steps to prevent his workmen from entering adjoining property and in the event of trespass occurring the Contractor shall be held entirely responsible.

Areas located immediately outside the construction area are known to contain mines and unexploded ordnance (UXO). Contractors assume all risks when venturing in or out of the designated work area.

1.3.2.2 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.

1.3.2.3 SUBCONTRACTORS

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

2.0 LIST OF CODES AND TECHNICAL CRITERIA:

The following codes and technical criteria and those referenced therein shall be required for this project. References within each reference below shall be required and adhered to. If there is conflict in the criteria the most stringent requirement shall be applied. This list is not exhaustive and is not necessarily complete. The publications to be taken into consideration shall be those of the most recent editions.

ACI 301M Specifications for Structural Concrete (edition per latest IBC), American Concrete Institute

ACI 318 Building Code Requirements for Structural Concrete (edition per latest IBC), American Concrete Institute

ACI 530/ASCE 5/TMS 402, Building Code Requirements for Masonry Structures (edition per latest IBC)

AISC 360 Specification for Structural Steel Buildings (edition per latest IBC), American Institute of Steel Construction

American Water Works Association, ANSI/AWWA C651-99 standard

ASCE 7, Minimum Design Loads for Buildings and Other Structures (per latest IBC)

ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning

ASME - American Society for Mechanical Engineering

ASTM - American Society for Testing and Materials

ASTM-D-1586 Standard Test Method for Standard Penetration Test

AWS D1.1, Structural Welding Code – Steel (edition per latest IBC), American Welding Society

EIA ANSI/TIA/EIA-607: (1994) Commercial Building Grounding/Bonding Requirement Standard

EPA, 625/1-80-012 (Design Manual: Onsite Wastewater Treatment and Disposal Systems)

Factory Mutual (FM) Approval Guide-Fire Protection (2002)

IBC - International Building Codes, latest edition (and its referenced codes including those inset below)

IEEE C2, National Electrical Safety Code (NESC), latest edition

IFGC – International Fuel Gas Code, latest edition

IMC – International Mechanical Code, latest edition

IPC – International Plumbing Code, latest edition

Lighting Handbook, IESNA, latest edition

NFPA 1, General Fire Protection, latest edition

NFPA 10, Portable Fire Extinguishers, latest edition

NFPA 58, Liquefied Petroleum Gas Code, latest edition

NFPA 70, National Electrical Code, 2005 edition

NFPA 72, National Fire Alarm Code, 2002 edition

NFPA 75, Standard for the Protection of Information Technology Equipment

NFPA 80, Fire Rated Doors and Windows, latest edition

NFPA 101, Life Safety Code, 2006 edition

NFPA 110, Standard for Emergency and Standby Power Systems, 2005 edition

NFPA 221, Standard for

Chimneys, Fireplaces, Vents, And Solid Fuel–Burning Appliances, latest edition

NFPA 1141, Site Fire Protection, latest edition

SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Standards and Guides, latest editions

International Mine Action Standards, latest edition; (see http://www.mineactionstandards.org for copy of standards)

TM 5-811-1 Electrical Power Supply and Distribution

UFC 1-200-01, Design: General Building Requirements, latest edition

UFC 1-300-07A Design Build Technical Requirements, latest edition

UFC 1-300-09N, Design Procedures, latest edition

UFC 3-220-03fa Soils and Geology

UFC 3-230-03a, Water Supply, 16 Jan 2004

UFC 3-230-04a, Water Distribution, 16 Jan 2004

UFC 3-230-06a, Subsurface Drainage, 16 Jan 2004

UFC 3-230-07a, Water Supply: Sources and General Considerations, 16 Jan 2004

UFC 3-230-08a, Water Supply: Water Treatment, 16 Jan 2004

UFC 3-230-09a, Water Supply: Water Storage, 16 Jan 2004

UFC 3-230-10a, Water Supply: Water Distribution, 16 Jan 2004

UFC 3-230-13a, Water Supply: Pumping Stations, 16 Jan 2004

UFC 3-230-17FA, Drainage in Areas Other than Airfields, 16 Jan 2004

UFC 3-240-03N, Operation and Maintenance: Wastewater Treatment System Augmenting Handbook, 16 Jan 2004

UFC 3-240-04a, Wastewater Collection, 16 Jan 2004

UFC 3-240-09fa Domestic Wastewater Treatment 16 Jan 2004

UFC 3-240-07fa Gravity Sewers 16 Jan 2004

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

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

UFC 3-310-01, Structural Load Data, latest edition

UFC 3-310-02A, Structural Design Criteria for Buildings, latest edition

UFC 3-501-03N, Electrical Engineering Preliminary Considerations, 16 Jan 2004

UFC 3-520-01, Interior Electrical Systems, 10 June 2002

UFC 3-530-01AN, Design: Interior and Exterior Lighting and Controls, 19 Aug 2005

UFC 3-540-04N Design: Diesel Electric Generating Plants, 16 Jan 2004

UFC 3-550-03FA Design: Electrical Power Supply and Distribution Systems, 1 Mar 2005

UFC 4-020-03FA, Security Engineering: Final Design, latest edition

UFC 4-022-01, Security Engineering: Entry Control Facilities/Access Control Points, latest edition

UFC 4-022-03, Security Engineering: Fences, Gates, and Guard Facilities, latest edition

UL 752, Bullet Resisting Equipment, 2000 or later

USCINCCENT OPORD 97-1

Overseas Environmental Baseline Guidance Document, Department of Defense, May 2007

The publications to be taken into consideration shall be those of the most recent editions.

Unified Facility Criteria (UFC) is available online at http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

In addition, technical criteria provided in USACE-AED Design Requirements (most recent version) shall be required for use in design and construction specifications as indicated in the following documents. The following design criteria shall be used:

AED Design Requirements – Voltage Drop Calculations Process, latest version

AED Design Requirements - Site Layout Guidance, latest version

AED Design Requirements - Well Pumps & Well Design/Specifications, latest version

AED Design Requirements – Water Tank and Water Distribution Systems, latest version

AED Design Requirements - Booster Pumps, latest version

AED Design Requirements – Chlorinators, latest version

AED Design Requirements - Hydro-Pneumatic Tanks, latest version

AED Design Requirements - Jockey Pumps, latest version

AED Design Requirements - Water Tanks, latest version

AED Design Requirements – Hydrology, latest version

AED Design Requirements - Culvert and Causeway Design, latest version

AED Design Requirements - Sanitary Sewer and Septic Systems, latest version

AED Design Requirements - Grease Trap, latest version

AED Design Requirements - Oil-Water Separator, latest version

AED Design Requirements - Package Wastewater Treatment Plants and Lagoons, latest version

AED Design Requirements - Vertical Curves, latest version

AED Design Requirements – Horizontal Curves & Super elevation, latest version

AED Design Requirements – Geotechnical Investigations for USACE Projects, latest version

Standards other than those mentioned above may be accepted if the standards chosen are internationally recognized and meet the minimum requirements of the specified standards. The Contractor shall be prepared to submit proof of this if requested by the Contracting Officer.

2.1 AED DESIGN REQUIREMENTS DOCUMENTS

Unless specifically stated herein, AED Design Requirements documents (latest version) listed above shall be adhered to in this contract. These documents are available from the AED-N website located at: http://www.aed.usace.army.mil/engineeringtop2010.asp. These documents shall be used as the basis for design and construction, and for selecting options within the United Facilities Guide Specifications (UFGS). It is the Contractor's option to use specifications contained in the AED Design Requirements Documents, when provided, or to adapt the UFGS specifications to match the requirements provided in the AED Design Documents and specifications. Site or project specific data and requirements in the AED Design Requirements documents shall supersede UFGS language where there are differing criteria, which must be evaluated and selected.the Contractor.

3.0 SITE DEVELOPMENT

3.1 GENERAL

The project includes furnishing all materials, equipment and labor for constructing electrical, water, communication, sanitary sewer and storm sewer service lines, as applicable, and connecting to the existing utility networks.

3.2 ENVIRONMENTAL PROTECTION

3.2.1 APPLICABLE REGULATIONS

The Contractor shall comply with all Host Nation laws, rules, regulations or standards concerning environmental pollution control and abatement with regard to discharge of liquid waste into natural streams or manmade channels. The Contractor shall review host nation and U.S. Government environmental regulations with the contracting officer prior to design and discharge of any liquid wastes into natural streams or manmade channels.

3.2.2 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed non-compliance with the foregoing provisions. 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.

3.2.3 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.

3.2.4 DISPOSAL

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

3.3 CIVIL SITE DEVELOPMENT

3.3.1 SITE PLAN

The Contractor shall prepare plat or plan of property as part of the design package consisting of a Boundary Survey of coordinates listed in the 01010 located at Nirkh district, Wardak Province, Afghanistan. The survey shall show the closure of the property boundary consisting of identifying all property corners, establishing horizontal and vertical control listing all bearing and distances of property lines from the centerline of all adjacent roads. The Contractor shall place property corner markers and a monument on the property showing site elevations, coordinate grid systems and WGS 84 latitude longitude. This survey shall meet the requirements of World Geodetic System 1984 in decimal degrees. The survey design shall include topographic map and the locations of all building corners, structures, major trees, road right of ways, names of roads, drainage features, widths of roads, easements, right of ways, setbacks, parking and paving areas, storage containers, stoops, sidewalks and walkways, above ground utilities, electrical and bunker locations. The Contractor shall identify and show Perimeter Security Walls, fences, Hesco barriers, Guard Towers and Entry Control Point structures. The Contractor shall locate the facilities in general agreement with the drawings included and any requirements in the Scope of Work 01010. All site features shall be clearly defined and dimensioned on the site plan. Buildings shall be located to provide access for emergency vehicles and fire fighting. Roads and parking areas shall be designed for turning radius of the largest vehicle entering the compound. The site plan shall show geometric design of the site, including applicable dimensions of all exterior facilities, mechanical equipment, pavements, utilities, etc. Required facilities are described in the following sections of this specification. All roads and areas where tractor-trailer vehicles will travel shall be designed for the worst case turning radius. Design and construction of roads and pavements shall be based on recommendations from geotechnical investigation required herein. All site plans and master plans shall be drawn in the following projection and datum for incorporation into the U.S. Army Corps of Engineers GIS system:

WGS 1984 UTM Zone 42 N

3.3.2 DEMOLITION

Demolition shall include removal of all structures, foundations, pavements, and utilities, to include clearing and grubbing. All refuse and debris shall be disposed of off-site as described in paragraph DISPOSAL. Holes and depressions shall be backfilled and compacted in lifts not to exceed 2000 mm in height unless specified otherwise. Fill materials shall be composed of satisfactory soils or aggregates defined in ASTM D 2487 as GW, GP, GM, SP, SM, and SW. Minimum soil compaction shall be 95 percent of maximum density as defined in ASTM D 1557.

Scrap metal shall be the property of the Host Government. The scrap metal on site shall be moved to an area away from the site perimeter as directed by the Contracting Officer's Representative and left for the

Host Government to remove and/or salvage. Demolished fencing and concertina wire shall be neatly rolled up for reuse by the host government. Likewise, used fence posts and outriggers shall be neatly stockpiled for reuse by the host government.

3.3.3 SITE GRADING & DRAINAGE

The Contractor shall provide all necessary site grading to insure adequate drainage so that no areas will be flooded due to a rainfall of a 10-year frequency. Drainage of the area should be compatible with the existing terrain. Building floor elevation shall be a minimum 150 mm above grade and slope away from the building on all sides at a minimum of three percent for 3 m. Protection of facilities from flood waters originating offsite of an installation is required and shall be based on a rainfall for a 25-year frequency event. This shall include the design or evaluation of bridges, culverts and causeways on road projects.

Rainfall data utilized for hydrology calculations shall be based on data obtained from meteorological records collected in Afghanistan. National agencies may be consulted for data. In the absence of site specific data, intensity-duration-frequency curves contained in the AED Design Requirements – Hydrology, latest edition shall be used by extrapolating the rainfall intensity information from the stations in closest proximity to the project. Under no circumstances will relationships developed by extrapolation from foreign countries be used for hydrologic studies.

3.3.4 ROADS

Aggregate roads are required within the compound. All two lane roads shall be a wearing surface 7.3 m (24 ft) wide and all one lane roads shall be 4 m (13 ft) wide, unless otherwise noted, graded for proper drainage, provided with necessary drainage structures and completed with prescribed surfaces in accordance with applicable sections of UFC 3-250-18FA and UFC 3-250-01FA. Aggregate pavement surface should consist of 200 mm (8 in) thick aggregate base course material compacted to 95 percent maximum proctor density, placed above 150 mm of scarified subgrade compacted to 95 percent maximum density . and shall be surfaced with minimum 100 mm (4 in) fine graded stone in accordance with the applicable sections of UFC 3-250-09FA, unless otherwise noted. Provide a one m wide shoulder on both sides of roadways, consisting of a surface of aggregate base course material and it should be 150 mm thick @ 2.0 percent slope. Contractor shall notify the Contracting Officer immediately if initial site survey determines that the area hydrology requires major drainage structures or bridges. The Contracting Officer shall be immediately notified if the required lengths of road or pre-existing conditions are determined to be substantially or materially different than the above-described conditions/estimates.

3.3.4.1 BRIDGES AND SITE GRADING PLAN

Preliminary investigation indicates no need for bridges or major drainage structures. The Contractor shall notify the Contracting Officer immediately if initial site survey determines that area hydrology requires major drainage structures or bridges. The Contractor shall design a site grading plan that provides positive drainage and minimizes the requirement for major structures in a cost effective manner.

3.3.4.2 PARKING AREAS AND MOTOR POOLS

Contractor shall construct parking and storage areas using aggregate surface. Aggregate pavement surface should consist of 150 mm (6 in) thick Aggregate Base Course (ABC) material compacted to 95 percent maximum proctor density, placed above 150 mm of scarified sub-grade compacted to 95 percent maximum density. Provide a one m wide shoulder around all parking areas and motor pools, consisting of a surface of an ABC material and it should be 150 mm thick @ 2.0 percent slope.

The ABC material must be well graded, durable, uniformly moistened, and mechanically stabilized by compaction. Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure in ASTM D 1557.

3.3.5 FORCE PROTECTION DESIGN

The Contractor shall design and construct force protection measures to include a complete Perimeter Security Wall, Guard Towers, Compound Illumination System, Security Communication Systems, and Entry Control Points (ECP's). ECP's shall be composed of a Primary ECP, Stand-Off ECP, and Secondary ECP. The Force Protection design shall incorporate minimum setbacks for new facilities to maximum extent possible as permitted by size of the site and the requirements of the user.

3.3.5.1 PERIMETER SECURITY WALL

Native stone masonry walls with concrete core as illustrated on the provided contract drawings, 600 mm thick, shall be constructed around the perimeter of the site. The height of the walls shall measure at least 2.4 m from the inside grade. Inside grade shall in all cases be higher than outside grade. The wall shall be capped with a cast-in-place reinforced concrete capping. Outriggers (see paragraph below) to support six strands of barbed wires and a single-coil concertina style razor wire shall be provided and installed by the Contractor. Site grading must slope away from the walls for at least a distance of 5 m. The wall shall be designed to prevent visual access to the inside of compound by all pedestrian and vehicular traffic outside the compound which may require the wall to be built at a higher level in some locations. Any penetrations through the Perimeter Security Wall shall only be for site drainage purposes and shall have force protection such as a welded bar grill, welded grating, or other pre-engineered barrier.

3.3.5.2 ECP GATES

3.3.5.2.1 SWINGING GATES

Double Swing Gates shall be provided for vehicle access at the Primary and Secondary Entry Control point and be constructed of steel and be a pair of 3.65 m wide x 2.4 m high steel leaves, constructed of 5 mm steel plate skins, steel tube frame, and steel tube intermediate posts and rails. A Personnel Gate shall be provided for personnel access and be constructed of steel and be 1.5 m wide x 2.4 m high steel leaves, constructed of 5 mm steel plate skins, steel tube frame, and steel tube intermediate posts and rails. Gate design shall insure it is dimensionally stable, square, true and planar. Gate leaves shall not rack, shake or deflect during operation and the hinges are to be designed and constructed to support the entire weight of each leaf. Gates shall have a sufficient number of hinges, anchor mounted to the exterior masonry walls, to support each gate leaf. Provide a locking mechanism that holds the gates together when in the closed position as well as a drop bolt that engages a steel sleeve embedded in the pavement. Each gate shall be provided with viewports 200 mm x 50 mm. Vehicular swing gates shall be certified to stop a 6,800 kg (15,000 lb) vehicle traveling at 48 kph (30 mph). The vehicular swing gates shall be able to stop the vehicle and cargo, although an allowable gate deflection of 0.9 m (3 ft) will be permitted. The vehicular swing and personnel gates will have three strands of tensioned wire installed on top. The gates will be painted two coats of good quality metal primer and two coats of a good quality finish coating. The final color selection will be made by the COR from samples provided by the Contractor.

3.3.5.3 OUTRIGGERS

Outrigger supporting arms shall be "Y" shaped with middle post, securely embedded 400mm by a 50mm diameter metal tube into the top of the wall. Posts shall conform to ASTM F 1083, Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded. Outriggers shall be spaced a maximum of 3000mm on center.

3.3.5.4 REINFORCED BARBED TAPE

Reinforced barbed tape shall be 600 mm diameter concertina style coil consisting of 31 loops. Each loop shall consist of 19 barb clusters per loop. Adjacent coils loops shall be alternately clipped together at three points about the circumference to produce the concertina effect upon deployment. Spacing between attachments points when deployed shall be 400 mm. The reinforced barbed tape shall be

fabricated from 430 series stainless steel with hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A 176. Each barb shall be a minimum of 30.5 mm (1.2 inch) in length, in groups of 4, spaced on 102 mm (4 in) centers. The stainless steel core wire shall have a 2.5 mm (0.098 in) diameter with a minimum tensile strength of 895 MPa. Sixteen gauge stainless steel twistable wire ties shall be used for attaching the barbed tape to the barbed wire. The reinforced barbed tape shall be equivalent to NSN: 5660-01-457-9852.

3.3.5.5 CHAIN-LINK FENCE AND GATES

Provide chain-link fence and gates around Well House, generator/fuel storage areas, and propane storage area at the dining facility. Chain link fence and gate fabric shall be No. 9 gage wires woven into a 50 mm diamond mesh. Fabric shall be coated with 366 grams per square meter zinc galvanizing. Posts shall be ASTM F 1083 Pipe, Steel, Hot Dipped Zinc Coated (Galvanized) Welded or equal. Top of fence and gates shall be provided with outriggers and reinforced barbed tape as indicated above. Post sizes shall be as shown on drawings.

The gates shall be swing type. Hinged gates shall be a pair of 3 m wide x 2.4 m high leafs, constructed of a steel tube frame and steel tube intermediate posts and rails. The design of the gates shall insure that it is dimensionally stable, square, true and planar. Gate leafs shall not rack or deflect when install on its hinges. Gates shall have a sufficient number of hinges, anchor mounted to the exterior masonry walls, to support each gate leaf. Provide a locking mechanism that holds the gates together when in the closed position as well as a drop bolt that engages a steel sleeve embedded in the pavement.

3.3.5.6 PRIMARY ECP

Primary ECP shall be laid out and constructed as illustrated in the Site Details drawings. A Guard Shack shall be provided outside the compound and a Gate House shall be provided inside the compound as part of the Primary ECP. Entrance to the Primary ECP shall be paved with the same surface as required for the interior roads of the compound, and shall have a two-leaf steel swinging gate. The gate shall be considered the Active Vehicular Barrier (AVB). Drop arms and guard shack shall be provided and located at a minimum distance of one and a half vehicles away from the entrance to serve as a checkpoint. Jersey Barriers or other approved alternatives shall be used to design and construct a Passive Vehicular Barrier (PVB) beyond and away from the checkpoint to significantly slow down approaching vehicles. The PVB shall be laid out to force approaching vehicles into a snake-like manoeuvre while approaching the checkpoint and to significantly slow them down.

Provide a rejection lane after vehicle inspection and before entrance to the compound.

3.3.5.6.1 DROP ARM GATES

The height of the beam shall be a minimum of 30 in above finished grade. The crash beam must be capable of blocking a minimum road width of 7.3 m. The crash beam shall be manually raised and lowered with less than 30 pounds of force. The end of the crash beam should include a locking pin with padlock acceptance for securing the beam when it is in the down position capable of stopping a 6,800 KG (15,000 lb) vehicle allowing a deflection of 0.9 m (3 ft), in addition to heavy duty steel gates into the compound.

3.3.5.6.2 CONCRETE PVB

Barriers shall be concrete blocks of one meter by one meter by one meter dimensions. Similar arrangements of large stones (one cubic meter size), jersey barriers or equal sized obstacles may be used.

3.3.5.6.2.1 HESCO PVB

Hesco barriers shall be made of geo-textile fabric shall be 2 mm (0.08 in) non-woven polypropylene and bound with 8 gauge galvanized steel wire mesh size 7.62 cm (3 in) grid. The coil hinges and joining pins shall be 8 gauge hardened steel. Fill material shall be a mixture of sand and gravel. The gravel shall not be more than 1.8 cm (¾ in) in size. The materials shall be compacted in lifts no greater than 25 cm (10 in).

Bastions shall be provided with suitable foundations as recommended by the manufacturer depending on the height, and filled with a sand & gravel mixture. Provide a gravel base at least 50 cm (20 in) deep, and extending around the bottom edge of the barrier by at least 50 cm (20 in), for proper support and drainage. The gravel base material shall have no stones large than 2.5 cm (1 in), due to the risk of becoming projectiles in a blast.

Protection from UV light shall be provided with an application of a protective coating such as UV CAM, cement slurry not greater than 0.3 cm (1/8 in) thick. The cement slurry is a mixture of cement powder and water, mixed to a proportion of 1:1, but this may be adjusted to suit the application method. Sand may also be added as necessary.

Submittal Requirements:

a. The manufacturer of this product must have been in this business for at least 5 years.

b. Installers must be certified by the manufacturer.

c. Welded mesh and wire must be ASTM A641 Class 3

d. Geo-textile shall be ASTM D4632, D6241, D4355, D4751 & D4491.

e. Structural calculations must be prepared by a licensed engineer and must be submitted and approved by the Government prior to installation

3.3.6 LOUDSPEAKERS AND ALARM SYSTEM

Install Loud Speaker & Alarm System that can alert the entire compound via panic button from any tower or guard post station. Speaker & Alarm System shall be exterior grade components to withstand severe weather conditions of cold, heat, rain, sleet, and dust storms and to be completely understandable during these conditions from any point within the compound. All wires shall be installed in conduits.

3.4 CIVIL UTILITIES

3.4.1 WATER

3.4.1.1 GENERAL

The Contractor shall provide water distribution mains, branches, service connections to include all pipe, valves, bends, thrust blocking, fittings and appurtenances. Exterior water line construction shall include service to all buildings as described in the Scope of Work Section 01010. The required average daily flow (ADF) shall be the average daily demand (ADD) per person - derived from 190 liters (or 50 gallons) per capita per day (lpcd) – times a capacity factor, times the effective population. A capacity factor of 1.5 shall be used if the effective population is less than or equal to 5,000. The capacity factor for larger populations is found in UFC 3-230-07a, Water Supply: Sources and General Considerations guidance. The capacity factor shall be utilized as described in the following paragraph. In the event potable or non-potable use water is required prior to completion of the water facilities infrastructure the Contractor may be issued a Request for Proposal to provide non-potable (tank truck) and potable (bottled or other reliable source) consumption. Provide a minimum of one outside water hydrant (hose spigot) for all buildings with water service. All buildings with water supply shall have a water meter installed in a locked cabinet area inside the building.

Features of the water system shall be sized to provide flow or storage capacity as follows:

- Water Well Pump Capacity - Capacity and total dynamic head (TDH) shall be based on an adjusted ADF (ADD, times the population, times the capacity factor) over a 16 hour period).

- Water Tank - Capacity shall be 7,000 Gallons.

- Booster Pumps – For installations with fewer than 400 persons, the capacity shall be based on the installation wide, total fixture unit flow. For installations with greater than 400 persons, the capacity shall be based on the installation wide, total fixture unit flow or 2 times the average daily flow (16 hour basis), whichever is greater. Three identical pumps shall be provided which are all sized to deliver 50 percent of the calculated capacity. Pumps shall automatically alternate to distribute wear and shall automatically turn on and off based on demand and system pressures. The total dynamic head (TDH) of the booster pumps shall be calculated to maintain a minimum, residual system pressure of 40 psi at the calculated capacity unless stated otherwise in the contract documents. Either a bladder style expansion tank or a hydro-pneumatic tank shall be supplied when booster pumps are used in the water system.

- Hydro pneumatic tanks – Volume and pressure regulation to maintain a pressure range provided in the technical requirements based on a rate equal to the ADF (ADD x c x CF).

- Water Mains – Diameter based on the installation fixture unit flow or two times the ADF (ADD x c x CF) and velocity requirements per this guide unless a minimum diameter is specified which is adequate to provide flow and meet the specified maximum velocity. The flow through the system shall be distributed on the basis of fixture unit flow in each the buildings serviced or per contract

- Water Service Lines - Diameter based on fixture units of the building serviced or per contract

3.4.1.2 WATER WELLS

The Contractor shall construct water well(s) inside the compound, to provide sufficient supply for the facility. The new well capacity shall be based on the allowable safe yield of the new well determined by a well pump test as described in the USACE- AED Design Requirements - Well Pumps & Well Design/Specifications, latest version. The new well site shall be at a location approved by the Government. The new well site shall be no closer than 75 m from any existing wells. Well construction shall be in accordance with the USACE-AED Well Design Guide and Water Well Guide Specification.

After de-mining, but prior to the construction of any structures, the Contractor shall submit a well test plan, drill and test the water well, conduct well design activities, and submit all required information to AED for review prior to installing any permanent well features. Drilling shall not proceed without an AED Engineering approved well drilling plan. A plan for decommissioning dry wells shall be included with the well drilling plan. It is acknowledged that water may not be available at the site despite Contractor good faith efforts to find it. The Contractor shall drill one well to a depth of 120 meters in an attempt to find water. If water cannot be found the contractor shall immediately notify the Contracting Officer's Representative (COR). Contractor must still furnish all other parts of the water distribution system as described in the specifications.

Well Capacity shall be equal to one day's demand delivered over 16 hours of pumping time.

Well construction shall be in accordance with AED Design Requirements - Well Pumps & Well Design/Specifications, latest version - which includes, but is not limited to, requirements for well screen, casing, gravel pack, well pump, disinfection, and testing requirements. All design requirements, material specifications, and testing contained in this document shall be used and submittals shall be made promptly in accordance with Section 01335. Failure to follow the construction and submittal procedures outlined may, at AED's discretion, result in rejection of the well and, the Contractor having to remove the well casing and screen, re-drill the well and reinstall the proper features per the approved design.

Well Depth. The well shall be drilled to a minimum depth of 20 m below the existing water table. The depth of the permanent well shall take into consideration the drawdown depth, screen depth and pump submergence as described in the AED Design Requirements document.

Casing - Selection of the casing diameter, material and depth shall be per the AED Design Requirements document. All wells will be cased 150 mm above grade (i.e., base of pit, ground surface, etc.) and be fitted with a lockable cap with air gap (vacuum relief during pumping). Each section of casing will be joined with standard couplings and full-threaded joints, or by proper welding, so that all joints are sound and watertight. Well casing alignment shall not interfere with the proper installation and operation of the pump.

Screen - The casing will be fitted with a well screen that will permit maximum transmission of water without clogging. The material of construction, opening requirements, minimum lengths and placement shall be per the AED Design Requirements document.

Sealing - The drilling process will create a hole (borehole) larger than the casing. To protect the well and properly finish construction, the entire space between the casing and the edge of the borehole will be filled with gravel, overburden, or concrete as follows:

a. The upper 3 m of the well bore will be sealed with cement grout. Grout shall be placed in one continuous mass and be impermeable.

b. The space around the well screen will be filled with material that will form a filter and not clog the slots in the screen (e.g. washed coarse sand for a fine bore wall material).

c. The space between the top of the filter pack and the base of the grout seal may be backfilled with overburden or other clean earth material.

Crushed Stone. Per the AED Design Requirements, crushed stone for well sealing shall consist of crushed stone containing angular shapes and surfaces with no rounded surfaces shall be used for sealing the solid wall casing and edge of the borehole area. All aggregate shall contain less than 5 percent of shale, clay lumps, coal, lignite, soft or unfragmented stone, or other deleterious materials.

Source protection - Surface drainage within 30 m of wellhead shall ensure no ponding, flooding or collection of runoff adjacent to the well. This can be accomplished through surface grading or use of gravel drains to modify site drainage in the vicinity of the well. Contractor shall identify all sources of contamination and ensure the proposed well site meets minimum standoff distances as indicated below:

Sewage storage areas (outhouses, tanks, individual sewage pits, lagoons, and WWTP) – 30 m

Septic fields (infiltration galleries) – 30 m

Fuel storage, engine maintenance/repair – 30 m

Well Pump – A submersible, centrifugal pump shall be installed inside the casing set no less than 2.0 m from the base of the excavation. Control of the pump shall be by means of a Hand-Off-Auto (HOA) switch. In the “Auto” position, the pump shall be started and stopped automatically by water levels in the water storage tank. Pump shall start at low level and shall stop at high level. Level controls shall be adjustable. Manual start shall be the Hand position.

Expansion Tank – Provide bladder style expansion tank for well pump to minimize pressure surges and water hammer effects.

3.4.1.3 WELL PUMP TESTING

Well pump testing and water clarity testing after well development shall be per the requirements in AED Design Requirements - Well Pumps & Well Design/Specifications, latest version or most recent version.

3.4.1.4 WATER QUALITY SAMPLING AND ANALYSIS

The Contractor shall perform water quality sampling and testing at the source. The Contractor shall utilize well-qualified and equipped testing capability in the project site area, if available. If professional testing

services are not available in the area, the Contractor shall submit an alternative practical testing source for approval.

See USACE-AED Well Pumps & Well Design Guide with Attachment A – Guide Specifications for Drinking Water Wells, latest version and Appendix A of TM 5-813-3 (UFC 3 230 08a Water Supply Water Treatment, January 2004) for requirements for laboratory testing.

3.4.1.5 WELL HOUSE

At new wells or springs, construct a permanent well house with reinforced concrete slab floor, reinforced CMU walls, and a reinforced concrete roof in accordance with the provided Contract drawings. The floor of the well house shall slope away from the casing approximately 3 mm per 300 mm (1/8 in per foot) and drain to the outside. Floor of well house shall be minimum 300 mm above adjacent grade. The well house design should be such that the well pump, motor, and drop pipe could be removed readily by providing an insulated hatch in the building roof provided with a hasp and lock. The well house shall protect valves and pumping equipment plus provide freeze protection for the pump discharge piping beyond the check valve. The well house shall be insulated and have a heating unit provided. The entry door shall be made of heavy duty metal and metal frame with no louvers. The well shall be protected from unauthorized use by a security fence with lockable gate. Provide outriggers, barbed wire and concertina wire on fence and gate.

3.4.1.6 RAW WATER DISINFECTION

Contractor shall perform disinfection of the well water in accordance with AED Design Requirements - Well Pumps & Well Design/Specifications, latest version. Bacteriological samples shall be collected and examined in accordance with Standard Methods for the Examination of Water and Wastewater by a qualified lab as approved by the Contracting Officer.

3.4.1.7 SERVICE BOOSTER PUMPS

Contractor shall provide a booster pump station with capacities defined above with end suction or split case double suction horizontal split case (frame mounted) centrifugal pumps arranged in parallel for pumping water storage into the main distribution system. The pumps and controls shall be designed to supply and maintain acceptable system pressure throughout the distribution network given the full range of flow conditions (low flow to peak). Provide suitable expansion tank for booster pump system sized for anticipated pressure surges, if hydro pneumatic tanks are not to be used. The suction side of the service booster pumps shall have an eccentric reducer and gate valve installed. The discharge side shall have a gate valve, check valve between the pump and the gate valve and concentric reducer, pressure gage and air relief valve.

3.4.1.8 WATER STORAGE TANK

Contractor shall provide a steel, elevated water storage tank. The bottom of the storage tank shall be 20 meters above the finished grade at the base of the tank and shall be at least 20 m above the finished floor elevation of the highest building ground floor. Volume of the water storage tank shall be 7000 gallons. The storage facility shall be located above drainage areas and locations subject to flooding as approved by the Contracting Officer. Overflow and air vents shall be screened so that birds, rodents and debris cannot enter the reservoir.

The tank shall meet all applicable codes for potable water storage. The interior coatings for the tank shall meet NSF/ANSI 61 requirements. Contractor shall ensure that all elements of the Water Tank have been designed, fabricated, and erected in accordance with AWWA D100-05 Welded Carbon Steel Tanks for Water Storage and AWWA D102-06 Coating Steel Water Storage Tank. The Contractor shall provide plan details illustrating the proposed Water Tank to Tower platform connections.

The following geotechnical investigation will be conducted at the proposed location of the water tank:

Current geotechnical requirements as outlined in the AED Design Guide for Geotechnical Investigations provide geotechnical information for shallow foundation structures constructed on AED projects. The geotechnical characteristics of the soils at the location of the water tower must be adequate to support the deep loadings generated by the tower and water tank. The following are required prior to approval for construction of water towers using the design provided by AED. Information listed below should be submitted to AED as soon as practicable to allow construction of the tower in a timely manner.

1. Site Characteristics Information.

A. Site plan showing location of the tower.

B. Elevation of original and finished grade at the center of the tower foundation.

C. Finished floor elevations of every building on the site receiving water.

D. Top of concrete of pedestal containing anchor bolts used to secure the tower.

2. Borehole Information.

A. Boring log for water tower foundation. Diameter shall be 150 mm or 200 mm diameter. Depth shall be 16.5 m from finished grade. Location shall be center of water tower foundation.

B. Samples shall be collected every 0.75 m.

C. Sample results for EVERY sample taken during boring operation.

(1) Penetration Test and Split-Barrel Sampling of Soils using ASTM D 1586.

(2) Laboratory Determination of Water (Moisture) Content of Soils using ASTM D 2216.

(3) Liquid Limit, Plastic Limit, and Plasticity Index of Soils using ASTM D 4318.

(4) Classification of Soils for Engineering Purposes (Unified Soil Classification System) using ASTM D 2487.

3.4.1.9 DISINFECTION & CHLORINATION SYSTEM

Use hypochlorite compounds for disinfection. A manufacturer assembled, self-contained, skid-mounted, hypo-chlorinator consisting of mixer, mixing tank, pump pipe injector, and control panel shall be used to feed a sodium hypochlorite solution of 1- 5 percent available chlorine into the system. Hypochlorite compound may be a liquid or solid form. The pump shall feed a hypochlorite solution in proportion to the water demand. The hypo-chlorinator shall have a pumping rate, liters per day (lpd) (gallons per day (gpd)) adequate to deliver 5 percent available hypochlorite solution adjustable to the quantity of water being produced from the source. The chlorine-feeding system shall consist of controls and devices necessary for a complete operating system. Dosage rate will vary somewhat depending on actual pump production rate and available residual chlorine in the system. Contractor shall determine the required dosage rate milligrams per liter (mg/l) to maintain the required chlorine residual (usually 0.2-0.4 mg/l) in the distribution system. Chlorine solution tank shall be large enough to hold a three days supply of hypochlorite solution. A fresh solution shall be prepared every two or three days because the solution may lose its strength over time and this will affect the actual chlorine feed rate. The hypochlorite shall be stored in a cool dry place. Sodium hypochlorite can lose from two to four percent of its available chlorine content per month at room temperature. Contractor shall verify required minimum residual chlorine in accordance with local requirements verified and approved by the Contracting Officer. The chlorination system shall have the capability for manually adjusting the dosage rate and be installed in such a manner that the system can be easily disconnected and bypassed in the event of health safety or routine maintenance and repair. Disinfection of water mains shall be in accordance with AWWA standard C651-

86 and disinfection of storage facilities in accordance with AWWA standard C652-86. The package disinfection system shall be located in the well pump house.

3.4.1.10 HAND PUMP

The Contractor shall provide a hand pump with separate intake piping in the well casing to allow water supply during periods without electricity. Water drawn from the well by the hand pump shall not flow through the electric well pump. The pump shall be valved so that it can be used to fill the water storage tank or discharge to a spigot outside the well house. The capacity of the pump shall be at least 20 liters per minute (5.3 gpm). The pump shall be lever operated while standing in the well house.

3.4.2 WATER DISTRIBUTION SYSTEM

3.4.2.1 GENERAL

The Contractor shall provide a water distribution system. The distribution network shall be laid out in a combination grid and looped pattern with dead ends not exceeding 30 m (99 ft). Use similar piping materials for all buildings and pipe runs in the distribution system for efficiency of future maintenance activities. Distribution lines shall not be less than 100 mm (4 in) in diameter. Dead end sections shall not be less than 150 mm (6 in) diameter and shall either have blow off valves or fire hydrants (flushing valves) installed for periodic flushing of the line. Any pipe with a fire hydrant on the line shall be at least 150 mm (6 in) in diameter. Water supply distribution shall connect to a building service at a point approximately 1.5 m (5 ft) outside the building or structure to which the service is required. All piping and joints shall be capable of at least 1.03 MPA (150 psi) leakage testing and 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise specified. Pipe diameters shall be adequate to carry the maximum flow of water at velocities less than 1.5 m/sec (5 ft/sec). Piping segments where velocities less than 0.15 m/sec (0.5 ft/sec) are anticipated, shall be noted and brought to the attention of AED. The operating pressure range shall be between 276 kPa (40 psi) to 517 kPa (75 psi) at all points of the distribution system. If pressures greater than 690 kPa (100 psi) cannot be avoided, pressure-reducing valves shall be used. . . Contractor shall not use HDPE pipe and fittings without specific approval from AED through the variation process. This applies even if the existing project water distribution system had this pipe material. Pipe material shall meet the requirements of Pipe below.

Adequate cover must be provided for frost protection. A minimum cover of 800 mm (2’-8”) is required to protect the water distribution system against freezing. Water lines less than 1.25 m (4 ft) deep under road crossings shall have a reinforced concrete cover of at least 150 mm (6 in) thickness around the pipe extending out to one m from each road edge.

3.4.2.2 PIPE

The Contractor shall provide pipe of adequate strength, durability and be corrosion resistant with no adverse effect on water quality.

3.4.2.2.1 WATER MAINS AND BRANCHES

Pipe material for water mains and branches shall be PVC or Ductile Iron (DI). The exterior surface of the pipe must be corrosion resistant. Distribution lines shall be 100 mm (4 in) and larger and shall be reduced only at the junction of building connections. Pipe diameters shall be selected to meet the previously specified flow, velocity, and pressure conditions. If Ductile Iron (DI) pipe is installed underground the pipe shall be encased with polyethylene in accordance with AWWA C105. Ductile iron pipe shall conform to AWWA C104. DI fittings shall be suitable for 1.03 MPa (150 psi) pressure unless otherwise specified. Fittings for mechanical joint pipe shall conform to AWWA C110. Fittings for use with push-on joint pipe shall conform to AWWA C110 and C111. DI fittings shall be cement mortar lined (standard thickness) in accordance with C104. All pipes and joints shall be capable of at least 1.03 MPa (150 psi) and 1.38 MPa (200 psi) hydrostatic test pressure unless otherwise specified herein. Polyvinyl Chloride (PVC) pipe shall conform to ASTM D 1785. Plastic pipe coupling and fittings shall be

manufactured of material conforming to ASTM D 1784, Class 12454B. PVC screw joint shall be in accordance with ASTM D 1785, Schedules 40, 80 and 120. . Pipe less than 80mm (3 inch), screw joint, shall conform to dimensional requirements of ASTM D schedule 80. Elastomeric gasket-joint, shall conform to dimensional requirements of ASTM D 1785 Schedule 40 or SCH 80 pipe and fittings.

3.4.2.2.2 WATER SERVICE

Building service lines will be sized according to the following guidance. Water service connections from the mains to the buildings shall vary from 19 mm, 25 mm, 38 mm, 75 mm, to 100 mm as calculated, depending on the maximum flow velocity and minimum pressure requirements as determined by hydraulic analysis of fixture flows. Pipe service connections from the distribution main to the building shall be either Polyvinyl Chloride (PVC) plastic Schedule 80 ASTM D 1785 or copper tubing conforming to ASTM B 88M, Type K, annealed. PVC pipe couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B. Contractor shall not use uPVC or HDPE for any of the water pipes.

3.4.2.2.3 HYDROSTATIC, LEAKAGE, AND DISINFECTION TESTS

The Contracting Officer will be notified not less than 48 hours in advance of any water piping test and will be given full access for monitoring testing procedures and results. Where any section of water line is provided with concrete thrust blocking for fittings or hydrants, tests shall not be made until at least 5 days after installation of concrete thrust blocking, unless otherwise approved. Pressure and leakage testing shall be as specified in AED Design Requirements – Water Tank and Water Distribution Systems, latest version.

3.4.2.2.4 PRESSURE TEST

After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa (200 psi). Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants and valves shall be carefully examined during the partially opened trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered following this pressure test shall be removed and replaced and retested until the test results are satisfactory.

3.4.2.2.5 LEAKAGE TEST

Leakage tests shall be conducted after all pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and, during the test, water lines shall be subjected to not less than 1.38 MPa (200 psi). Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure to within 34.5 kPa (5 psi) of the specified leakage test pressure after the pipe has been filled with water and all air expelled. Pipe installation will not be accepted if leakage exceeds the allowable leakage, as determined by the following formula:

L = 0.0001351ND (P raised to 0.5 power), where:

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the government.

3.4.2.2.6 BACTERIOLOGICAL DISINFECTION

3.4.2.2.6.1 DISINFECTION PROCEDURE

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. After pressure tests have been completed, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. Flushing will be performed in a manner and sequence that will prevent recontamination of pipe that has previously been disinfected. The chlorinating material shall be liquid chlorine, calcium hypochlorite, or sodium hypochlorite. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipelines shall be chlorinated using only the above-specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than one ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times.

3.4.2.2.6.2 SAMPLING

For each building connected to the water system, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with approved methods. The commercial laboratory shall be verified to be qualified by the appropriate authority for examination of potable water. Contractor shall submit a water sampling protocol for approval. This shall include at a minimum the name of the laboratory, parameters to be tested, the Company conducting the sampling, and the sample locations.

3.4.2.2.6.3 ACCEPTANCE REQUIREMENTS

The disinfection shall be repeated until tests indicate the absence of bacteria for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained. All retests shall be conducted at the Contractor’s expense.

3.4.2.2.6.4 TIME FOR MAKING TESTS

Except for joint material setting or where concrete thrust blocks necessitate a 5 day delay, pipeline jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.4.2.2.6.5 CONCURRENT TESTS

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be recorded for submission and approval. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government. Pressure and leakage testing may be conducted concurrently. Hydrostatic tests and disinfection may be conducted concurrently using water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-accomplished.

3.4.3 VALVES

3.4.3.1 GATE AND BUTTERFLY VALVES

Valves (Gate valves w/box) shall be placed at all pipe network tees and cross intersections, and the number of valves shall be one less than the number of lines leading into and away from the intersection. For isolation purposes valves shall be spaced not to exceed 3600 mm (12 ft). Gate valves shall be in accordance with AWWA C 500 and/or C509. Butterfly valves (rubber seated) shall be in accordance with C504 et. al. The valves and valve boxes shall be constructed to allow a normal valve key to be readily used to open or close the valve. Provide traffic-rated valve boxes. Provide concrete pad, one m (40 in) square, for all valve boxes. Valves shall be pressure rated to 1.38 MPa (200 psi).

3.4.3.2 VACUUM AND AIR RELEASE VALVES

Air release valves are required to evacuate air from the main high points in the line when it is filled with water, and to allow the discharge of air accumulated under pressure. Vacuum relief valves are needed to permit air to enter a line when it is being emptied of water or subjected to vacuum. Contractor shall submit manufacturer's data for properly sized combination air and vacuum release valves and determine their locations on the distribution system subject to review and approval of the Contracting Officer.

3.4.3.3 BLOW-OFF VALVES

The Contractor shall provide 40-50 mm (1-5/8 – 2 in) blow-off valves at ends of dead end mains. Valves should be installed at low points in the mains where the flushing water can be readily discharged to natural or manmade drainage ditches, swales or other.

3.4.3.4 THRUST BLOCKING

Contractor shall provide concrete thrust blocking at any point where the layout of the system changes the direction of the flow, increases the velocity, or decreases or stops the flow. At these points, the pipes and fittings must be anchored and kept from moving or pulling apart by the use of thrust blocks installed against undisturbed earth.

3.4.4 SANITARY SEWER

3.4.4.1 GENERAL

There are no functional or salvageable sanitary sewer collection, treatment or disposal facilities at this site. The Contractor shall obtain topographic information or other maps that show vegetation, drainage channels and other land surface features such as underground utilities and related structures that may influence the design and layout of the collection system. If maps are not available, or do not provide satisfactory information or sufficient detail of the site, field surveys shall be performed. Sanitary sewers less than 1.25 m (4 ft) under road crossings shall have reinforced concrete cover at least 150 mm (6 in) thick around the pipe. Concrete cover will extend out to at least 1 m from each road edge.

Exterior sanitary sewer line construction shall include service to all buildings as described in the Scope of Work Section 01010. Contractor shall design sanitary sewer collection system using approved field survey data and finished floor elevations. Depending upon the topography and building location, the most practical location of sanitary sewer lines is along one side of the street. In other cases they may be located behind buildings midway between streets. Main collection sewers will follow the most feasible route to the point of discharge. The sewer collection system shall be designed to accommodate the initial occupancy and a reasonable expansion capability. Sewer collection capacity shall be based on the two times the average daily wastewater flow unless minimum diameter specified is adequate to provide flow and required maximum velocity; wastewater flow through the system shall be distributed on the basis of fixture unit flow in each the buildings serviced by multiplying the proportion of the total fixture flow from each building or facility times the total wastewater flow for the project or installation as determined above.

All sewers shall be located outside of the roadways as much as practical, and minimize the number of roadway crossings. To the extent practical, a sewer from one building shall not be constructed under another building, or remain in service where a building is subsequently constructed over it. Construction required shall include appurtenant structures and building sewers to points of connection with building drains 1.5m (5 feet) outside the building to which the sewer collection system is to be connected.

The Contractor shall use the following criteria where possible to provide a layout which is practical, economical and meets hydraulic requirements:

a. Follow slopes of natural topography for gravity sewers.

b. Check subsurface investigations for groundwater levels and types of subsoil encountered. If possible, avoid areas of high groundwater and the placement of sewers below the groundwater table.

c. Avoid routing sewers through areas which require extensive restoration or underground demolition

d. Depending upon the topography and building locates, the most practical location of sanitary sewer lines is along one side of the street. In other cases they may be located behind buildings midway between streets. The intent is to provide future access to the lines for maintenance without impacting vehicular traffic.

e. Avoid placing manholes in low-lying areas where they could be submerged by surface water or subject to surface water inflow. In addition, all manholes shall be constructed 50 mm higher than the finished grade, with the ground sloped away from each manhole for drainage.

f. Sewer lines shall have a minimum of 800 mm of cover for frost protection.

g. Locate manholes at change in direction, pipe size, or slope of gravity sewers.

h. Sewer sections between manholes shall be straight. The use of a curved alignment shall not be permitted.

i. If required by the design, locate manholes at intersections of streets where possible. This minimizes vehicular traffic disruptions if maintenance is required.

j. Sewer lines less than 1.25 m deep under road crossings shall have a reinforced concrete cover of at least 150 mm thickness around the pipe or shall utilize a steel or ductile iron carrier pipe. It is recommended to continue the reinforced concrete cover or carrier pipe a minimum of one m beyond the designated roadway.

k. Verify that final routing selected is the most cost effective alternative that meets service requirements.

3.4.4.2 PROTECTION OF WATER SUPPLIES

The Contractor shall ensure that the sewer design meets the following criteria:

a. Sanitary sewers shall be located no closer than 30 m (100 ft) horizontally to water wells or reservoirs to be used for potable water supply.

b. Sanitary sewers shall be no closer than 3 m (10 ft) horizontally to potable water lines; where the bottom of the water pipe will be at least 300 mm (12 in) above the top of the sanitary sewer, horizontal spacing shall be a minimum of 1.8 m (6 ft).

c. Sanitary sewers crossing above potable water lines shall be constructed of suitable pressure pipe or fully encased in concrete for a distance of 2.7 m (9 ft) on each side of the crossing. Pressure pipe will be as required for force mains in accordance with local standards and shall have no joint closer than 1 m (3 ft) horizontally to the crossing, unless the joint is fully encased in concrete.

3.4.4.3 QUANTITY OF WASTEWATER

System capacity shall be calculated based on a hydraulic waste load equivalent to 80 percent of the required daily demand based on (Population) x (Per Capita Demand) x (Capacity Factor) = *(0.80) x (175 personnel) x (190 L/capita/day) x (1.5 Capacity Factor)* = ***39,900 lpd*.** The Gravity Sanitary sewers shall be designed in accordance with the AED Design Requirements for Sanitary Sewer and Septic Systems, latest version to flow at a maximum in the following way: 1) sanitary sewer laterals, mains and trunk lines flow velocities shall be designed to provide a minimum velocity of 0.6 m per second (mps) or 2.0 feet per second (fps), 2) a minimum velocity of 0.8 to 1.05 mps (2.5-3.5 fps) at the peak diurnal flow rate, 3) flows shall be based on allocating the proportion of the average daily or peak daily flow to each building or facility on the basis of fixture unit flow developed for the plumbing design, and 4) minimum pipe slopes shall be provided regardless of the calculated flow velocities to prevent settlement of solids suspended in the wastewater. Minimum pipe slopes are provided in the AED Design Requirements for Sanitary Sewer and Septic Systems.

Minimum Slopes for Sewers	
Sewer Pipe Size (mm)	Minimum Slope in meters per 100 meters
100	1.00
150	0.62
200	0.40
250	0.28
300	0.22
350	0.17
400	0.15

Unless otherwise indicated (see Building Connections and Service Lines), gravity sewer pipe shall be installed in straight and true runs in between manholes with constant slope and direction. Adequate cover must be provided for frost protection. A minimum cover of 800 mm (32 in) will be required to protect the sewer against freezing.

3.4.4.4 MANHOLES

The Contractor shall provide standard depth manholes (MH), (depth may vary) an inside dimension of 1.2 m (4 ft). Manholes shall be made of cast-in-place reinforced concrete with reinforced concrete cover. Alternate pre-cast manhole option shall taper to a 750 mm (30 in) cast iron frame that provides a minimum clear opening of 600 mm (24 in). In every case, the manholes, frames and covers shall be traffic rated, H-20 load rating. All manholes shall be provided with a concrete bench with a flow line trough, smoothly formed to guide waste flow to the outlet pipe from the inlet pipe(s). The top surface of the bench shall be above the crown of all pipes within the manhole. All surfaces of the bench shall be sloped smoothly toward the trough to guide flow, even under peak flow conditions. Sanitary sewer lines shall enter at the manhole flow line. Where the invert of the inlet pipe would be more than 0.5 m above the manhole floor, a drop inlet shall be provided. No internal drop structures shall be permitted at lift stations. Inlet to lift station wet wells shall enter below the lowest water level of the pump operating

range, and if necessary a drop inlet approach pipe external to the lift station may be used to avoid cascading influent flow.

3.4.4.4.1 MANHOLE DESIGN REQUIREMENTS

Manholes are required at junctions of gravity sewers and at each change in pipe direction, size or slope, except as noted hereinafter for building connections. Manholes shall be installed at start of all main runs.

3.4.4.4.2 SPACING

The distance between manholes must not exceed 120 m (400 ft) in sewers of less than 460 mm (18 in) in diameter. For sewers 460 mm (18 in) and larger, and for outfalls from wastewater treatment facilities, a spacing of up to 180 m (600 ft) is allowed provided the velocity is sufficient to prevent sedimentation of solids.

3.4.4.4.3 PIPE CONNECTIONS

The crown of the outlet pipe from a manhole shall be on line with or below the crown of the inlet pipe.

3.4.4.4.4 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete, traffic rated in any case to an H-20 load rating. Cast iron frames and covers shall be traffic rated, circular with vent holes.

3.4.4.4.5 STEPS FOR MANHOLES

Steps shall be cast iron, polyethylene coated, at least 15 mm (5/8 in) thick, not less than 400 mm (16 in) in width, spaced 300 mm (12 in) on center.

3.4.4.5 PIPE

Pipe shall conform to the respective specifications and other requirements as follows: Provide Polyvinyl Vinyl Chloride (PVC) conforming to ASTM D 3034, Type PSM with a maximum SDR of 35, size 380 mm (15 in) or less in diameter. PVC shall be certified as meeting the requirements of ASTM D 1784, cell Class 12454 B. Minimum pipe sizes for the main lines shall be 200 mm (8 in) diameter and service lines/laterals shall be a minimum of 150 mm (6 in) diameter. Smaller diameters shall not be used. Contractor may not use uPVC or HDPE pipe.

3.4.4.5.1 FITTINGS

Fittings shall be compatible with pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and requirements as follows: provide PVC fittings conforming to ASTM D 3034 for type PSM pipe.

3.4.4.5.2 JOINTS

Joints installation requirements shall comply with the manufacturers installation instructions. Flexible plastic pipe (PVC or high density polyethylene pipe) gasket joints shall conform to ASTM D3212.

3.4.4.5.3 BRANCH CONNECTIONS

Branch connections for new piping installations shall be made using regular fittings. Branch connections for upgrades or repairs may be made using regular fittings or solvent-cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034. The minimum depth of the cover over the pipe crown shall be 0.8 m (32 in).

3.4.4.5.4 BUILDING CONNECTIONS AND SERVICE LINES

Building connections and service lines will be planned to eliminate as many bends as practical and provide convenience in rodding. Bends greater than 45 degrees made with one fitting should be avoided; combinations of elbows such as 45-45 or 30-60 degrees should be used with a cleanout provided. Connections to other sewers will be made directly to the pipe with standard fittings rather than through manholes. However, a manhole must be used if the connection is more than 31 m from the building cleanout. Tee connections to the main or branch are not allowed. Service connection lines will be a minimum of 150 mm (6 inch) diameter and laid at a minimum one percent grade. Service laterals shall be at least 150 mm (6 inch) and sloped to maintain the minimum velocity as described in paragraph “Gravity Sewer.”

3.4.4.5.5 CLEANOUTS

Cleanouts must be installed on all sewer-building connections to provide a means for inserting cleaning rods into the underground pipe. Install manufactured wye fittings. In lieu of a wye fitting, an inspection chamber may be installed. The inspection chamber shall be of the same construction as a manhole. Preferably the cleanout will be of the same diameter as the building sewer, and never be smaller than 150 mm (6 in). Cleanouts shall be located within 1m from the building.

3.4.4.6 GREASE INTERCEPTORS

Grease interceptors are used to remove grease from wastewater to prevent it from entering the sanitary sewer and septic systems. All Dining Facilities (DFACs) shall incorporate preliminary treatment with use of a grease interceptor prior to the sanitary sewer system. The only waste lines upstream of the grease interceptor shall be grease laden waste from the kitchen or other areas. Grease interceptor design shall be based on AED Design Requirements - Grease Trap, latest version. The grease interceptor shall be of reinforced cast-in-place concrete, reinforced precast concrete or equivalent capacity commercially available steel, with removable three-section, 9.5 mm checker-plate cover, and shall be installed outside the building. Steel grease interceptors shall in be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Concrete shall have 28MPa minimum compressive strength at 28 days. The grease interceptor shall connect to the sanitary sewer system.

Contractor shall provide bollards around the tank and construct a minimum 4 m wide access road from the closest roadway to the grease interceptor for a pump truck. The access road shall be of the same material as the main roads in the compound. Under no circumstance shall the grease interceptor be installed inside the building. Provide outside water spigot for cleaning.

3.4.4.7 FIELD QUALITY CONTROL

3.4.4.7.1 FIELD TESTS AND INSPECTIONS

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment and incidentals required for testing.

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically a full circle of light through the pipeline when viewed from the adjoining end of the line. When pressure piping is used in a non-pressure line for non-pressure use, test this piping as specified for non-pressure pipe.

Test lines for leakage by either infiltration tests or ex-filtration tests. Prior to testing for leakage, backfill trench up to at least lower half of the pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe to prevent movement during testing, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

Infiltration tests and ex-filtration tests: Perform these tests for sewer lines made of specified material, not only concrete, in accordance with ASTM C 969M, ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969M and ASTM 969.

Low-pressure air tests: Perform tests as follows:

a. Concrete pipe: Test in accordance with ASTM C 924M, ASTM C 924. Allowable pressure drop shall be given in ASTM C 924M ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M, ASTM C 924;

b. Ductile-iron pipe: Test in accordance with the applicable requirements of ASTM C 924M, ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924M, ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M, ASTM C 924;

c. PVC Plastic pipe: Test in accordance with applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.4.4.7.2 DEFLECTION TESTING

Deflection testing will not be required however; field quality control shall ensure that all piping is installed in accordance with deflection requirements established by the manufacturer.

3.4.5 WASTEWATER TREATMENT SYSTEMS

Permanent base waste water treatment plants shall be designed in accordance with Unified Facilities Guide Specifications UFGS 44 41 13, Prefabricated Biochemical Wastewater Treatment Plant, Oct 07.

. Septic systems shall be designed and installed in accordance with AED Design Requirements - Sanitary Sewer and Septic Systems, latest version. Contractor shall provide a minimum 4 m wide access road to the septic tank. Bollards shall be installed around the absorption field as well as the septic tank. The access road construction shall be of the same thickness and material as the roadway on the compound. The access roadway shall tie to the nearest road network. Septic tank and leach field disposal systems shall be limited to effective design populations under 300 personnel.

Contractor shall not use sewage holding tanks for the wastewater disposal system unless specifically required as the only method in the contract section 01010 and 01015. When soil conditions make septic systems with leach fields unfeasible, the Contractor may request consideration for sewage holding tanks from the USACE-AED Engineering Branch. This policy applies only for facilities with 60 personnel or less and shall be considered on a case by case basis.: . .

3.4.6 SEPTIC SYSTEM

Generally when determining an appropriate septic tank location, the Contractor shall provide protection for the septic system by ensuring that vehicles, material storage, and future expansion shall be kept away from the area. Signage or other prevention methods (i.e. pipe bollards) shall be used to provide this protection. The finished grade for the site shall ensure that storm water runoff shall drain away from the site to prevent ponding, inflow, and infiltration. Once an appropriate site is located, the Contractor shall conduct soil investigations for the site to determine ground water levels, soil conditions, and the percolation rate. Septic systems shall be designed and installed in accordance with UFC 3-240-09A, Domestic Wastewater Treatment, 16 January 2004 edition, and the following guidance:

3.4.6.1 SITE SURVEY

The Contractor shall conduct a topographic survey to determine existing site characteristics. The Contractor shall conduct a utility survey to determine the locations of any nearby water lines, wells, sanitary sewers, storm sewers and electrical lines.

3.4.6.2 PERCOLATION TESTING

At proposed sites for holding ponds and the absorption field, the Contractor shall perform percolation tests. Percolation testing shall be conducted in accordance with AED Design Requirements - Sanitary Sewer and Septic Systems (latest version).

3.4.6.3 SEPTIC TANK

Septic tanks are buried, watertight receptacles design and constructed to receive and partially treat wastewater. The tank separate solids from the liquid, provides limited digestion of organic matter, stores solids, and allows the clarified liquid to discharge for further treatment and disposal. Settle able solids and partially decomposed sludge accumulate at the bottom of the tank, while scum rises to the top of the tank's liquid level. The partially clarified liquid is allowed to flow through an outlet opening position below the floating scum layer. The clarified liquid will be disposed of to the absorption field for further treatment and disposal.

Factors to be considered in the design of a septic tank include tank geometry, hydraulic loading, inlet and outlet configurations, number of compartments and temperature. If a septic tank hydraulically overloaded, retention time may become too short and solids may not settle properly.

For Afghanistan, a baffled multi-compartment or dual chamber design shall be utilized. Refer to AED Design Requirements - Sanitary Sewer and Septic Systems (latest version) for sizing and details. The septic tank shall be designed with a length-to-width ratio of 2:1 to 3:1 and the liquid depth should be between 1.2 m and 1.8 m. This depth is determined by the outlet pipe invert elevation. If not specified in the contract, the septic tank shall be sized based on the average daily demand of 190 liters/capita/day, plus an additional 100 percent for sludge storage capacity and peak flows. The tank shall be constructed of reinforced, cast-in-place concrete, with a minimum compressive strength of 28 MPa at 28 days. When feasible, wastewater shall enter and exit on the short sides of the tank, which will allow the wastewater longer detention and settling time. The baffle tank shall have two compartments, with the first compartment (influent entry point) having 2/3 thirds the volume capacity of the tank. The tank shall have a minimum earth backfill cover of 300 mm. Access shall be provided at the entry (influent) and exit (effluent) points of the tank by installing reinforced concrete risers, with steel access hatches and gooseneck vents with bird and insect screens that will rise 50 mm above the finished grade.

3.4.6.4 ABSORPTION FIELD

Absorption fields (also termed "leach fields") are used, in conjunction with septic tank treatment, as the final treatment and disposal process for the wastewater treatment system. Absorption fields normally consist of perforated distribution pipe laid in trenches or beds that are filled with rock. Refer to AED Design Requirements - Sanitary Sewer and Septic Systems (latest version) for absorption field sizing and performance requirements. The septic tank effluent shall be distributed by a perforated pipe or leaching chamber, and allowed to percolate through the ground, where it is filtered and treated by naturally occurring bacteria and oxygen. If percolation testing indicates that soil absorption rates are not between 0.1 min/25cm and 60 min/25cm, the Contractor shall notify the COR.

Once effluent is released from the septic tank, it travels by gravity through a solid PVC pipe, at a minimum one percent slope, to the distribution box or dosing tank. The distribution box is a reinforced concrete structure that distributes the septic tank effluent evenly throughout the absorption field through several 100mm diameter perforated (distribution) pipes or leaching chambers. The distribution pipes or chambers shall be evenly distributed over the absorption trenches or beds; the perforated distribution pipes shall have a maximum slope of 0.5 percent and shall be capped at the end of each pipe. Leaching chambers shall be installed level. Generally, distribution piping is spaced from the one meter to 1.8 m apart and is not longer than 30 m. See below for installation details of leaching chambers.

3.4.6.5 AS-BUILTS

Upon completion of installing the sanitary sewer and septic systems, the Contractor shall submit editable CAD format As-Built drawings. The drawings shall show the final product as it was constructed in the field, with the exact dimensions, locations, materials used, and any changes made to the original design.

3.4.7 STORM SEWER SYSTEMS

3.4.7.1 DESIGN STORM RETURN PERIOD (BASELINE FREQUENCY)

Developed portions of the site installation such as administration, industrial and barracks areas, shall be based on a rainfall of 10-year frequency. Basic system design shall be in accordance with UFC 3-230-17A, Chapter 2. Potential damage or operational requirements may warrant a more severe criterion or in certain areas a lesser criterion may be appropriate. The design of roadway culverts and other on-site storm drainage features & structures will normally be based on 10-year rainfall event. Protection of installations against flood flows originating from areas exterior to the base installation shall be based on a 25-year or greater rainfall depending on cost vs. benefit considerations.

3.4.7.2 STORM DRAINAGE SYSTEM DESIGN

The Contractor shall be responsible for the complete design of the storm drainage system. Drainage of runoff from turf areas onto pavements shall be minimized. If storm drain piping is required it shall comply with the requirements in this section. Where storm drain pipes are of different diameters, the pipe crown elevations should be matched at the drainage structure. Storm drain lines shall be located outside of paved areas to the extent possible. Under no circumstance shall storm drain lines be located beneath buildings. Erosion control shall be provided for all storm drain structures during construction. Water from roof down spouts shall be drained off building site. All storm drain pipe and structures shall comply with the requirements specified in Section 33 40 01 STORM-DRAINAGE.

3.4.7.3 HYDRAULIC DESIGN

New storm drain pipes shall be designed for gravity flow during the design storm baseline unless otherwise approved by the Government. The hydraulic grade line shall be calculated for the storm drain system and all energy losses accounted for. Design computations shall adhere to procedures contained in UFC 3-230-17A. Storm drain systems shall be designed to provide a minimum flow velocity of 0.75 meters per second when the drains are one-third or more full. Storm drain pipes shall have a minimum diameter of 300 mm. Rectangular culverts passing under roads and through perimeter walls shall have a minimum width of 300 mm. Larger sizes shall be provided as required.

3.4.7.4 AREA INLETS

Area inlets shall be properly sized and designed to accommodate the design flows. All grates shall be of a “bicycle safe” design.

3.4.7.5 CONCRETE PIPE

Reinforced concrete pipe shall be a minimum Class III. Type I cement may be used only when sulfates in the soil are 0.1 percent or less and dissolved sulfates in the effluent are 150 ppm or less. Type II cement may be used only when sulfates in the soil are 0.2 percent or less and dissolved sulfates in the effluent are 1,500 ppm or less. Only Type V cement may be used if sulfates in the soil exceed 0.2 percent or dissolved sulfates in the effluent exceed 1,500 ppm. Concrete pipe shall be assumed to have a minimum design service life of 50 years unless the Contractor determines that conditions at the site will reduce the service life. Concrete culverts and storm drains shall be protected by a minimum of one m of cover during construction to prevent damage by heavy construction equipment.

3.4.7.6 CORRUGATED METAL PIPE

Corrugated Metal Pipe shall not be used.

3.4.7.7 PLASTIC PIPE

Stiffness of the plastic pipe and soil envelope shall be such that the predicted long-term deflection shall not exceed 7.5 percent. Plastic culverts and storm drains shall be protected by a minimum of one m of cover during construction to prevent damage by heavy construction equipment. Split couplers shall not be allowed for corrugated high-density polyethylene pipe. Plastic pipe shall be assumed to have a minimum design service life of 50 years unless the Contractor determines that conditions at the site will reduce the service life (then plastic pipe shall not be used).

3.4.8 OIL WATER SEPARATORS

Oil/water separators shall be utilized for all drains from industrial sites. Separators shall be installed as close as possible from the drain location. Storm sewer system shall not be mixed with sanitary sewer system and shall be in accordance with UFC 3-240-07FA, latest edition.

3.5 GEOTECHNICAL

3.5.1 SOIL INVESTIGATION

The Contractor shall develop all pertinent geotechnical design and construction parameters by appropriate field and laboratory investigations and analyses.

The Contractor shall produce a detailed geotechnical report containing, test boring location plan, test borings logs, test boring profiles, laboratory testing results of soil and rock, laboratory testing results.

Information in the report shall include, but not limited to: Existing geotechnical (e.g. surface and subsurface) conditions, location of subsurface exploration logs on site plan, exploration point, test boring location plan, test borings logs and profiles, geotechnical drilling inspection, laboratory testing results of soil and rock including physical properties, compaction test, consolidation test, strength tests and due to the presence of Loess soils a Lab must be able to perform the ASTM D-5333-96 Test to Measure the collapse potential of the soil. Engineering analysis including: Settlement, bearing capacity, lateral earth pressure, pile and pier capacity, seismic site class evaluation, formulation of recommendations for design and constructions of foundations, earthworks, pavement, groundwater control, Percolation Testing,

The Contractor shall produce a detailed geotechnical report containing both standard and specialized procedures for determination of physical and engineering properties of soil and rock. Information in the report shall include pavement design criteria (e.g. CBR values, K values), ground-water levels, and construction materials (e.g. concrete cement, asphalt, and aggregates). Also, a Geotechnical Lab shall be able to provide Pavement, Water Well, Retaining Wall and Deep Foundation Design Services: Pavement design, Soil/aggregate qualification testing (ASTM C-33): Gradation, Soundness, LA abrasion, Sand Equivalent ASTM D2419, Compressive test Cylinder, Compressive Test Grout Sample, Compressive Test Mortar Cylinder. Excavation Dewatering, Groundwater Controls, Well Design and Construction, Installation of Monitoring Wells, Groundwater Testing & Monitoring. Lateral earth Pressures, Embankment and Retaining Wall Design, Soil Stabilization. Load Tests, Pile Driving Inspection.

A Geotechnical Lab shall be able to perform soil and aggregate testing and all testing and field work shall be based on standards set forth in the American Standard Testing Material (ASTM) Specifications: Physical Properties: Soil Classification (ASTM D-2487/D-2488), Moisture Content (ASTM D-2216), Grain Size Analysis (ASTM C-136/C-117), Atterberg Limits (ASTM D-4318), Particle Size by wash sieve/Hydrometer Tests (ASTM D-421/D-422), Sieve Analysis (ASTM C-136), Specific Gravity (ASTM C-127/C-128/D-854), Slaking Durability. Compaction Test: Standard Proctor Compaction Modified Proctor Compaction. Moisture-density relationship-Proctor (ASTM D- 1557/D-698). Field Density: Sand Cone ASTM D-1556, Nuclear Methods ASTM D-2922. One dimensional consolidation properties of soils (ASTM

D 2435). Obtain undisturbed soil samples to provide data for estimation of foundation, embankment settlements and perform settlement analyses. Strength Tests: Measure soil strength through an Unconfined Compression test on soil ASTM D-2166, Unconfined Compression tests on rock, direct shear test of soils under consolidated drained conditions (ASTM D 3080). California Bearing Ratio (CBR): - (ASTM D-1883), Relative density –max/min – (ASTM D-4253/D-4254, Soil/aggregate qualification testing (ASTM C-33): Gradation, Soundness, LA abrasion, Sand Equivalent ASTM D2419.

3.5.2 COLLAPSIBLE SOILS

The Contractor is responsible for determining if the site is underlain with collapsible soils. Potential for collapsible soils may be indirectly identified by the following:
(a.) Low dry density correlated with Liquid Limit
(b.) Natural Water Content at Saturation - low soil saturation high potential for the soil to collapse
(c.) Low SPT- N Values indicative of loose soil, high void ratio and low soil strength
(d.) Dry density correlated with passing the #200 sieve. (CL-ML, SM-ML soils primarily mixing with lesser amount of sand and clay tend to correlate roughly with collapsible soils)
(e.) Void ratio of the soil describes porosity of the soil; loess soil void ratio is typically 0.9
The geotechnical engineer or geotechnical firm shall use the direct method described in ASTM D 5333 (1-D response to wetting test) to assess whether or not a site may exhibit collapse potential. For project sites where collapsible soils are identified the following procedures shall be followed for grading, drainage and foundation preparation.

3.5.2.1 GRADING

Water shall not be allowed to stand or pond on the site under any circumstances, during and upon completion of construction. This is especially critical around building foundations. The site shall be graded at all times during construction so that surface water flows into the constructed drainage ways. The grade shall fall a minimum of 150 mm for every 3,000 mm (5%). Finish grades shall drain surface water away from all sides of buildings. After completion of initial grading the entire site will be covered with a minimum of 150 mm of well graded gravel which will be compacted to 95% maximum dry density, as determined by the Modified Proctor laboratory procedure. All building roof drainage shall be collected in a gutter and downspout system which shall discharge at least 3000 mm from foundation walls into a concrete lined drainage way.

3.5.2.2 DRAINAGE

All required drainage facilities should be constructed first and the area sloped to provide draining with no ponding prior to the start of building construction. Ensure that all surfaces have and maintain some significant slope away from structures and off of paved areas e.g. 5 % slope around buildings and slope the paving away from the structure on all sides. Use a minimum slope of paved areas of 1.5% with 2% or 3% being preferable. Allow no areas where ponding could occur on the paved area. Also, in areas or slopes with exposed soils around the buildings where the pavement does not extend, these slopes should likewise be maintained a distance of 50 meters or more if possible away from the buildings.
Utility lines such as sewer lines, pressurized water lines, and storm drain lines should be sleeved or otherwise prevented from discharging any leaks into the foundation soils. Plastic pipes such as PVC could be used for the sleeves. If it were desired to have improved access to the utility lines, the sleeves could be cut in half long-ways, making a trough to catch the water. It may be that there will be so many utility lines for a given building that the use of sleeves would be greater effort and expense than constructing a utility trench large enough to house all of the lines. It would be necessary that the walls and bottom of the trench be reasonably water tight and sealed at joints. The walls could be cement block, concrete, or rock (limestone slabs or segments).

The bottom could be made of cement block, brick, concrete, rock, or asphalt concrete. The utility trench bottom would need to be continuously sloped with no ponds so that it would drain. However, that requirement should not be a major problem given that the sewer lines require a continuous slope anyway. At some point where the utility trench is well away from the building, say 30 to 50 m if possible, a manhole

can be constructed. This manhole does not need to be a true manhole, but rather a substantial lowered section where any leak water could collect and be periodically pumped out of the manholes. The manhole should be sealed the same as the rest of the utility trench.

Additional construction may be required by the contractor to transfer the additional drainage to the wadi outside of the perimeter walls. This will be decided by the drainage calculations performed and supplied by the contractor. The drainage shall be adequate to handle a minimum 25-year design storm. All building roof drainage shall be collected in a gutter and downspout system which shall discharge at least 3000 mm from foundation walls into a concrete lined drainage way. Excavations shall be covered at all times so that no rainfall enters the soil. Temporary grading around all excavations will be done as needed to keep all stormwater runoff from entering. It is recommended to redouble the efforts at quality control (QC) in piping, pressure test everything, and maybe use leak detectors. Capturing of any leaks from the utility lines with sleeves or troughs or utility trenches is very important.

3.5.2.3 FOUNDATION PREPARATION

To mitigate damage from any future soil collapses, over excavation of soil within the footprint of any foundation that is part of this contract will be required. Over excavation shall be to a depth of 2.5 meters within the entire footprint of the building and extend the excavations 1.5 m past the outer edge of the building footprint. Excavate the footings 2.5 meters below the level of intended bottom of the footing foundation and extend the excavation 1.5 meters beyond the external footing foundation outer perimeter. The backfill soil must be a well-graded soil with no more than about 10 % fines and should be from an offsite borrow location approved by the COR prior to construction. Compact the backfill with at least 9 passes of a 10 Tons vibratory roller and until a density close to 100% of the Modified Proctor maximum density is reached at a moisture content in the range of optimum moisture content (OMC) minus 2% to optimum. The purpose of this would be to ensure that the material being compacted back is superior to the natural material excavated. Use 30 cm loose lift layers unless difficulty in achieving the required density occurs. In this case, reduce the loose lift layer thickness to 15 cm.

The fill must meet the requirements of Paragraph "SATISFACTORY MATERIALS" in Section 01015 and be compacted per Paragraph "EXCAVATION AND COMPACTION OF FILL" also in Section 01015.
To ensure that fill meets requirements, at least two (2) samples must be classified per ASTM D 2487 from each truckload of fill brought onto site. It will be the contractor's responsibility to provide a temporary onsite testing lab as required in Section 01060 paragraph "SOILS TESTING LABORATORY. The lab will be capable of providing classifications within one day of material delivery from the borrow source. Material shall be stockpiled on site and properly covered against inclement weather until testing results have been approved by the COR. Once approved, the Contractor may proceed with placement of material. If it is determined that any material is unsatisfactory a second classification will be run. If the second classification also fails the entire truckload will not be used. If material is determined to be unsatisfactory that has previously been placed, the extent of material within the over excavation will be removed to ensure that collapsible soils are not used under any buildings.

It will be the Contractor's responsibility to provide as part of the geotechnical report a comprehensive action plan of how collapsible soils will be handled. This action plan will incorporate all remediation listed within Section 01010 and 01015 as well as any further remediation the contractor deems necessary. The action plan will describe in detail how each remediation will be implemented.

3.5.3 GEOTECHNICAL QUALIFICATIONS

A geotechnical engineer or geotechnical firm responsible to the Contractor shall develop all geotechnical engineering design parameters. The geotechnical engineer or geotechnical firm shall be qualified by: education in geotechnical engineering; professional registration; and a minimum of ten (10) years of experience in geotechnical engineering design. All laboratory staff must receive test performance training based on American Standards for Testing Materials (ASTM). The geotechnical Laboratory must be equipped with a complete range of equipment for performing tests that are congruent with ASTM

Standards and Regulations. The geotechnical firm conducting either the field investigation or laboratory work shall be certified by the Chief, Quality Assurance Branch USACE-AED. Certification document shall be submitted as part of the Geotechnical Report.

4.0 STRUCTURAL

4.1 GENERAL

This is a site-adapt contract. The construction drawings to be used to construct the site-adapt facilities are located in Appendix B to this contract. The site-adapt building structures shall be constructed exactly as provided in Appendix B.

Any new buildings or structures that are necessary but that are not included in the Site-Adapt building packages in Appendix B, shall be designed to the structural standards and design criteria noted in this Section 3.0 Structural. Calculations and construction drawings shall be submitted for any structures required but not included in the Appendix B attachment to this contract. Submittals shall be provided in accordance with the requirements of Section 01335 of this contract.

Field welding shall not be used for any part of the Main Structural Force Resisting System for significant structures. The Main Structural Force Resisting System is that part of the structural system providing the required resistance to all gravity loads (dead; live) and all lateral loads (wind; seismic). Bolted connections in lieu of welding are strongly recommended. Exemptions to these guidelines would be minor structural connections; including metal trusses bearing on a reinforced concrete roof, and non-load bearing applications. Certified shop welding of pre-engineered buildings and various structural members shall be permitted.

4.2 DESIGN

Design shall be performed and design documents signed by a registered professional architect and/or engineer. Calculations shall be in SI (metric) units of measurements. All components of the structures shall be designed and constructed to support safely all loads without exceeding the allowable stress for the materials of construction in the structural members and connections.

4.3 MATERIAL STRENGTHS AND STANDARDS

The Contractor shall use the following American standards to provide sound structural design if local standards are not available, relevant, or applicable. The Contractor shall follow American Concrete Institute Standards (ACI) for design and installation of all concrete structures.

Concrete	ASTM C 39 and ACI 318; 28 MPa (f'_c = 4,000 psi) minimum specified compressive strength @ 28 days, and maximum water-cement ratio of 0.45.
Steel Reinforcement	ASTM A 615; 420 MPa (F_y = 60 ksi) yield strength.
Welded Wire Fabric	ASTM A 185.
Anchor Bolts	ASTM F 1554; Grade 36 steel.
Bolts and Studs	ASTM A 307.
Plaster	ASTM C 926.
Concrete Masonry Units	ASTM C 90; Type I (normal weight, moisture control).
Mortar	ASTM C 270; Type S (ultimate compressive strength of 13 MPa).

Grout	ASTM C 476; 14 MPa (2,000 psi) minimum compressive strength @ 28 days (slump between 200 mm to 250 mm).
Structural Steel	ASTM A 36; 250 MPa (F_y = 36,000 psi).
Welding	AWS D1.1 (American Welding Society).

4.4 LOADS

4.4.1 DEAD AND LIVE

Dead loads consist of the weight of all materials of construction incorporated in the buildings. Live loads used for design shall be in accordance with the Structural Load Data, UFC-3-310-01, and edition as referenced herein.

4.4.2 SNOW

Snow Loads shall be calculated using a Ground Snow Load of 1.5 kPa.

4.4.3 WIND

Wind Loads shall be calculated using a "3-second gust" wind speed of 135 km/hr.

4.4.4 SEISMIC

The building and all parts thereof shall be designed for the seismic requirements as defined by the International Building Code referenced herein.

Spectral ordinates shall be S_s = 2.4g and S_1 = 1.2g.

4.5 STRUCTURAL CONCRETE

4.5.1 GENERAL

Concrete structural elements shall be designed and constructed in accordance with the provisions of the American Concrete Institute, Building Code Requirements for Structural Concrete, ACI 318.

4.5.2 MATERIALS

A minimum cylinder 28 day compressive strength of 28 MPa (4,000 psi) shall be used for design and construction of all concrete, except that 24 MPa (3,500 psi) shall be used for Shotcrete applications. Reinforcing steel shall be deformed bars conforming to American Society for Testing and Materials publication ASTM A 615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement. Concrete shall have maximum water-cement ratio of 0.45.

4.5.3 CONCRETE PLACING AND CURING

Where concrete is cast-against and exposed to soil, a minimum concrete cover over reinforcement of 75 mm (3 inches) shall be provided.

No concrete shall be placed when the ambient air temperature exceeds 32 degrees C (90 degrees F) unless an appropriate chemical retardant is used. In all cases when concrete is placed at 32 degrees C (90 degrees F) or hotter it shall be covered and kept continuously wet for a minimum of 48 hours. The curing requirements and recommendations in ACI 308 - Guide to Curing Concrete (and ACI 506 – Guide to Shotcrete) shall be followed for all temperature conditions. The Contractor shall submit to AED plans for placing and curing concrete during cold weather (per ACI 306 - Cold Weather Concreting) and hot weather (per ACI 305 - Hot Weather Concreting).

4.6 MASONRY

Masonry shall be designed and constructed in accordance with the provisions of Building Code Requirements for Masonry Structures, ACI 530/ASCE 5/TMS 402. Mortar shall be Type S and conform to ASTM C 270. Masonry shall not be used below grade.

All cells of exterior CMU walls shall be fully grouted. For interior CMU walls, only the reinforced cells need to be grouted. All interior and exterior CMU walls shall have reinforced concrete horizontal bond beams at the top and bottom of the walls and at a maximum spacing of 1,200 mm on center.

Brick and unreinforced masonry shall not be used as a construction material for any buildings.

4.7 STRUCTURAL STEEL

Structural steel shall be designed and constructed in accordance with the provisions of American Institute of Steel Construction (AISC), Specifications for Structural Steel Buildings. Design of cold-formed steel structural members shall be in accordance with the provisions of American Iron and Steel Institute (AISI), Specifications for Design of Cold-Formed Steel Structural Members.

4.7.1 PRE-ENGINEERED METAL BUILDING (PEB)

Pre-engineered metal building steel framing shall be designed for all vertical and lateral loads described herein, including dead, live, snow, wind, and seismic loads.

Pre-engineered metal building foundations, pedestals and column anchor bolts shall be designed based on the final reactions from the building manufacturer. Foundations will not be cleared for construction until these components are properly submitted, reviewed and approved by AED-North.

4.7.2 STEEL ROOF JOISTS

Steel roof joists shall be placed according to the roof design and roof manufacturer specifications. Steel purlins shall be installed perpendicular to the steel beams. Use continuous metal roof sheets from ridge to eave to avoid constructing roof seams. In lieu of the continuous metal roof sheets, the Contractor can submit a plan for roofing seams; however, the plan must show a detail of how leaks will be avoided, and the Contracting Officer before application must approve the plan. Steel “hat channels” can be installed for the connection to the CONEX box module. Provide all necessary metal framing for roof fascia and soffits. See structural paragraph for structural characteristics of steel joists.

4.7.3 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI Specifications and Tables. Joists shall be designed to support the loads given in the standard load tables of SJI Specifications and Tables.

4.7.4 STEEL DECK

Deck units shall conform to SDI Publication Number 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span three or more supports with flush, telescoped or nested 50 mm (2 inch) laps at ends, and interlocking, or nested side laps. Metal deck units shall be fabricated of steel thickness required by the design and shall be galvanized.

4.8 FOUNDATIONS

The geotechnical investigation shall determine the allowable soil bearing pressure. If the geotechnical investigation recommends an allowable soil bearing pressure less than what the design of the standard building utilized (see below for each building), then the Contractor shall redesign the footings based on

the geotechnical investigation's findings and shall notify the COR of this change in order to coordinate a modification.

The foundations for the following attached site-adapt buildings were designed for an allowable soil bearing pressure of 72 kPa (1500 psf):

Latrine Building
Trash Collection Point
POL Building
20 M Water Tower

The foundations for the following attached site-adapt buildings were designed for an allowable soil bearing pressure of 96 kPa (2000 psf):

Administration Building Type 6
Barracks Type 2
Barracks Type 3
Dining Facility Type 3
ECP Canopy
Fuel Canopy
Gate House
Guard Shack
Guard Tower
Secure Storage
Warehouse
Well House

Foundations shall be properly placed on suitable compacted ground area and shall be in accordance with the recommendations from the geotechnical investigation. Building foundations shall be founded a minimum of 800 mm below grade or below frost line, whichever is greater. Foundation designs shall be corroborated with the geotechnical findings and recommendations.

Ensure that footing sub-grades have been inspected and approved by the Contracting Officer prior to concrete placement.

4.9 EARTHWORK AND FOUNDATION PREPARATION

4.10 CAPILLARY WATER BARRIER

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, 75 micrometers, No. 200 sieve, or 37.5 mm and no more than 2 percent by weight passing the 4.75 mm No. 4 size sieve and conforming to the soil quality requirements specified in the paragraph entitled "Satisfactory Materials."

4.11 SATISFACTORY MATERIALS

Any materials classified by ASTM D 2487 as GW, GW-GM, GW-GC, SW, SW-SM, or SW-SC and free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

4.12 UNSATISFACTORY MATERIALS

Any materials which do not comply with the requirements set forth in the Satisfactory Materials paragraph. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other

organic matter, frozen material, and stones larger than 75mm. The Contracting Officer shall be notified of any unsatisfactory materials.

4.13 CLEARING AND GRUBBING

Unless indicated otherwise, remove tress, stumps, logs, shrubs, brush and vegetation, and other items that would interfere with construction operations within lines 1.5 m outside of the building and structure line. Remove stumps entirely. Grub out matted roots and roots over 50 mm in diameter to at least 460mm below existing surface.

4.14 STRIPPING

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

4.15 EXCAVATION AND COMPACTION OF FILL

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to at least 95 percent of the maximum dry density, as determined by the Modified Proctor laboratory procedure. ASTM D 1557 shall be used for producing the Modified Proctor moisture-density curve, unless the soil to be compacted includes more than 30 percent retained on the 19 mm (3/4"in) sieve. In this case, the Contractor shall replace the ASTM D 1557 laboratory compaction procedure with AASHTO T 180, Method D, corrected with AASHTO T 224.

During compaction, the moisture content of the soil shall be within 1.5 percent of the optimum moisture content, as determined by the Modified Proctor laboratory procedure. The thickness of compacted lifts shall not exceed 15 cm and the dry density of each compacted lift shall be tested by either sand cone (ASTM D 1556) or nuclear gage (ASTM D 2292). If the nuclear gage is used, it must first be compared to sand cone tests for each soil type to verify the accuracy of the nuclear gage measurements for moisture content, wet density, and dry density. Furthermore, every tenth nuclear gage test must be accompanied by a sand cone test and these verification data must be summarized and submitted to the Contracting Officer. Density tests shall be performed at a frequency of not less than one test for each 200 square meters and not less than two tests per compacted lift.

5.0 ARCHITECTURAL REQUIREMENTS

5.1 GENERAL

All materials and products to be used throughout the facilities under contract are to be in accordance with the provided drawings and specifications. . Different sub-contractors shall not use different material or standards under the contract. . Conflicts between criteria shall be brought to the attention of the Contracting Officer for resolution. In such instances, the Contractor shall furnish all available information with justification to the Contracting Officer.

IBC - International Building Code, latest edition

NFPA 101 - Life Safety Code, latest edition

5.2 DESIGN CRITERIA

Schematic designs for the facility types requested in this proposal are provided in Appendix A. These designs shall be used to create a complete and usable facility meeting the minimum requirements stated in these documents. The Codes, Standards, and Regulations listed in these documents shall be used in the construction of this project. The publications shall be the most recent editions. Standards other than those mentioned may be accepted provided they meet the minimum requirements and the Contractor shall submit proof of equivalency to the Contracting Officer for approval.

IBC - International Building Code, latest edition

NFPA 101 - Life Safety Code, latest edition

5.3 LIFE SAFETY/ FIRE PROTECTION/ HANDICAPPED ACCESSIBILITY

A life safety and fire protection analysis shall be completed prior to construction commencement. This analysis shall be documented in plans and in the design analysis. All spaces shall be classified following NFPA 101 or IBC. Whichever code is used shall be stated and referenced in the life safety plan. The facility shall comply with all other safety requirements of the NFPA 101. To the extent possible, all facilities shall be designed in accordance with recognized industry standards for life safety and building egress. An adequate fire alarm system and fire extinguishers, shall all be included as required. Due to the lack of adequate water volume and pressure, sprinkler systems are not feasible. In keeping with the intended function of these facilities, handicapped accessibility will not be incorporated this project. Due to the war contingency requirement, it is assumed that only able-bodied military and civilian personnel will use the facilities listed herein.

5.4 ANTITERRORISM / FORCE PROTECTION

Force protection/anti-terrorism measures for this location shall be as defined in 01010.

6.0 MECHANICAL

6.1 GENERAL

The work covered by this section consists of supply, fabrication, and installation of new building heating, ventilation and air-conditioning (HVAC) systems. It also includes the delivery to site, erection, setting to work, adjusting, testing, balancing and handing over in perfect operating and running condition all of the HVAC equipment including all necessary associated mechanical works.

6.2 SPECIALIST SUB-CONTRACTORS QUALIFICATIONS

The HVAC works shall be executed by an air-conditioning specialist sub-contractor experienced in the design and construction HVAC equipment to include conventional compression systems, heat pump units, and space heaters in satisfying the specified indoor design conditions.

6.3 CODES, STANDARDS AND REGULATIONS

The equipment, materials and works covered under the heating, ventilation and air-conditioning services shall conform to the referenced standards, codes and regulations where applicable except where otherwise mentioned under each particular clause.

6.4 VENTILATION & HEATING EQUIPMENT

Environmental control of the facilities shall be achieved by wall/ceiling fans, electric unit heaters or wood burning heaters (provided by User) as indicated in the drawings.

6.5 DUCTWORK

Ductwork shall be limited to that shown on the drawings. Ductwork shall be constructed of galvanized steel or aluminum sheets and installed as per SMACNA "HVAC Duct Construction Standards (Metal and Flexible)." Flexible non-metallic duct may be used for final unit/diffuser connection in ceiling plenums. These flexible duct run-outs shall be limited to 3 meters in length.

6.5.1 DUCT INSULATION

Duct insulation shall be provided for all supply ductwork that is not located in the conditioned space and for return ductwork not located within the conditioned space. All ductwork exterior to the building shall be insulated with a minimum RSI=0.88 (R5).

In general interior ducts shall be exposed to the rooms and will not be insulated. The heat lost or gained from the un-insulated ducts shall be considered as part of the heating or cooling of the conditioned space.

6.5.2 DIFFUSERS, REGISTERS & GRILLES

Diffusers, registers and grilles shall be factory fabricated of steel or aluminum and distribute the specified air quantity evenly over the space intended. The devices shall be round, half round, square, rectangular, linear, or with perforated face as determined by the design. Units will be mounted in ceilings, high sidewalls, or directly to ductwork and shall be sized for the airflow to be delivered with a maximum NC rating of 35. Pressure loss through the diffuser shall be considered in sizing the duct system and the system static pressure calculations.

6.5.3 BRANCH TAKE-OFFS

Air extractors or 45° entry corners shall be provided at all branch duct take-offs. Manual volume control dampers shall be included at the branch duct take-offs and where required to facilitate air balancing and shall be shown on the design drawings.

6.5.4 WALL PENETRATIONS

Building wall penetrations shall be carefully made so as not to deteriorate the structural integrity of the wall system. The Contractor shall consult with the building manufacturer, if possible, to determine the best way to penetrate the wall. If the building manufacturer is not available, a structural engineer shall be consulted. In either case, the recommendations of the engineer shall be strictly adhered to.

6.5.5 AIR FILTRATION

All supply air shall be filtered using manufacturer's standard washable filters mounted inside the unit. In addition, all outdoor air intakes shall be equipped with 50 mm (2 inch) thick washable filters.

6.6 VENTILATION AND EXHAUST SYSTEMS

All fans used for building ventilation, exhaust, and pressurization shall be selected for minimum noise level generation. All fans used for supply or roof/wall exhaust shall be centrifugal forward curved, backward inclined, or airfoil fans with non-overloading characteristics of high efficiency and quiet running design. The fans shall be of the heavy-duty type with durable construction and proved performance in a

desert environment. Each wall exhaust fan shall be provided with gravity dampers which close automatically when the fan is not running. The kitchen makeup air opening shall be provided with an interlocked motorized damper which closes automatically when the exhaust fan is not running. The intake opening shall be provided with filter and insect screen. Also, each fan shall be complete with vibration isolator, external lubricators, and all accessories and sound attenuators as necessary.

To reduce sand and dirt migration, outside air intakes shall be installed as high as possible within architectural constraints.

6.6.1 KITCHEN HOOD EXHAUST AND MAKE-UP AIR

Kitchen exhaust hood shall be constructed as shown on the drawings and the specifications. The cooks are accustomed to standing on top of the stoves in order to stir the large cauldrons of food. This common cooking practice should be taken into consideration when designing the exhaust hood. The height of the hood above the stovetop should be such that a man of average stature could stand upright without risk of hitting his head on the hood. Make up air intake shall be provided from the roof air intake and discharge through a linear diffuser directly in front of the hood and running the entire length of the hood. Makeup air capacity shall be 85% of the exhaust capacity. An in-line supply fan shall be installed.

To reduce sand and dirt migration, outside air intakes shall be located as high as possible within architectural constraints. The intakes shall be sized so that free air velocities are below 2.5 m/s (500 fpm). Each air intake shall be provided with a motorized damper which is interlocked with the exhaust fan.

6.6.2 SUBMITTALS

The Contractor shall submit the following for the equipment to be provided under this section of the specification: manufacturer's data including performance characteristics at design conditions; catalog cuts showing dimensions, performance data, electrical requirements, compliance with standards as stated in paragraph CODES, STANDARDS AND REGULATIONS; drawings indicating location and installation details.

6.7 ELECTRIC HEATERS

Electric heat trace cable for freeze protection shall not be provided as a substitute for space heating system.

6.7.1 UNIT HEATER

Electric resistance unit heaters shall be installed in spaces where only heating is required. Generally, unit heaters shall be mounted as high as possible. Unit heaters shall be of the industrial grade, very durable and securely fastened to the ceiling, wall or structure. Provide a self-contained electric heating unit, suspended from ceiling or structure, fan with at least two-speeds and heating elements. Provide control-circuit terminals and single source of power supply with disconnect. Heating wire element shall be nickel chromium. Include limit controls for overheat protection of heaters. Provide hard-wired tamper resistant integral thermostat located as indicated on the drawings.

6.7.2 SUBMITTALS

The Contractor shall submit the following for the equipment to be provided under this section of the specification: manufacturer's data including performance characteristics at design conditions; manufacturer's certificate stating that each unit will perform to the conditions stated, catalog cuts showing dimensions, performance data, electrical requirements, compliance with standards as stated in paragraph CODES, STANDARDS AND REGULATIONS; complete shop drawings indicating location and installation details.

The manufacturer shall also submit a 1 year warranty for each of the units.

6.8 TEST ON COMPLETION

After completion of the work, the Contractor shall demonstrate to the Contracting Officer that the installation is adjusted and regulated correctly to fulfill the function for which it has been designed. The Contractor shall test, adjust, balance and regulate the section or sections of concern as necessary until the required conditions are obtained. Coordinate with the Contracting Officer on when the test shall be scheduled. Include tests for all interlocks, safety cutouts and other protective device to ensure correct functioning. All such tests shall be carried out and full records of the values obtained shall be prepared along with the final settings and submitted to the Contracting Officer in writing.

The following tests and readings shall be made by the Contractor in the presence of the Contracting Officer and all results shall be recorded and submitted in a tabulated form.

a. Ambient DB and WB temperatures

b. Room Inside Conditions

i. Inside room DB & WB temperatures

ii. Air flow supply, return and/or exhaust

c. Electric Motors: For each motor

iii. (1) Speed in RPM

iv. (2) Amperes for each phase

v. (3) Power input in KW

6.9 ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

a. Note that electrical requirements for all HVAC systems shall be designed and installed to operate on the secondary power standard required herein. The existing power distribution system may require modifications or upgrades to support the additional power required by the HVAC unit. The Contractor is responsible to field verify all the conditions and provide complete shop drawings showing any incidental power upgrades. All electrical work shall comply with the National Electric Code.

b. All thermostats shall be wall-mounted. In lieu of a thermostat, a temperature sensor may be located in the same location. Wall-mounted thermostats shall be mounted 1.5 meters (5 feet) above the finished floor and be easily accessible. Operation of the control system shall be at the manufacturer's standard voltage for the unit.

6.10 WALL/CEILING FANS

6.10.1 WALL/CEILING FANS

Provide wall or ceiling fans as indicated in the drawings.

Wall fans shall be mounted approximately 2meters high on the wall and shall be the oscillating type. Wall fans shall be securely mounted on the wall and shall be hard wired. Do not provide plug in type wall fans.

Ceiling fans shall have reversible motors. Fans shall be centered or distributed evenly throughout the room. Coordinate placement with the lighting plan to prevent conflict or casting shadows. Fan mount shall be flush, standard, or angle mount depending on ceiling height. Fan shall be mounted such that the fan blade is approximately 2.5 meters (98 inches) above the finished floor. The fan shall be provided without light kit. The finish shall be factory painted white. The controls shall be wall-mounted from either

a single pole switch or from two (2) 3-way switches to provide on/off operation. The electrical supply shall be as indicated. Install per manufacturers' instructions.

6.10.2 SUBMITTALS

The Contractor shall submit the following for the equipment to be provided under this section of the specification: manufacturer's data including performance characteristics at design conditions; catalog cuts showing dimensions, performance data, electrical requirements, compliance with standards as stated in paragraph CODES, STANDARDS AND REGULATIONS; drawings indicating location and installation details.

6.11 LPG COOKING STOVE

Cooking area shall be provided canopy type exhaust only kitchen hoods and associated exhaust fans. These exhaust hoods shall include baffle type aluminum filters to trap grease/oil. Provide an upblast exhaust fan as shown on the drawings. The placement of the exhaust hood shall allow enough clearance for an average sized male to stand on top of the stove platform unobstructed, for standing on the stove is common local cooking practice. The higher than average placement of the hood will require the extension of the lip of the hood out further than normal, in order to catch the majority of the smoke and adequately vent the area. LPG tank shall be located out the DFAC covered in the fenced storage yard

New LPG stoves shall be installed with consideration to ease of cooking operation and daily cleanup. The new LPG stoves shall be set into a formed concrete opening such that it can easily be removed for replacement, maintenance and cleaning.

Each LPG stove shall be provided with three burners. The LPG stoves shall be of commercial quality and be capable of producing the highest BTU heat output with all three burners on. The center burner is low heat, center and middle burner is medium heat and all three burners is high heat. A shut off valve for each burner shall be provided at the face of the LPG appliance.

Piping from the LPG tanks to the respective LPG stoves shall be wrought iron, ASTM B36.10M or steel (black or galvanized), ASTM A53. The steel piping shall terminate in front of the LPG stoves with a shut off valve and quick disconnect nipple. A stainless steel flexible hose shall connect from the LPG stove to the steel piping. Each end of the flexible hose shall be provided with quick disconnect fittings.

The LPG piping shall not be embedded in the concrete floor. The propane piping shall be routed from the exterior and to the respective propane stoves by passing the piping through the concrete platform.

Piping passing through the exterior wall and the concrete platform shall be provided with pipe sleeves.

6.11.1 LPG FUEL STORAGE/DISTRIBUTION

LPG Storage and Distribution shall be provided to support operation of the LPG stoves for cooking and boiling tea. The storage of fuels shall consist of above-ground steel bottles. The standard bottle size is 100 gallons. LPG tanks shall be secured using chain to prevent the bottles from toppling over. LPG storage tanks shall be provided and installed in accordance with NFPA 58. The LPG storage tanks shall be installed on a concrete pad, and provided within an enclosure to protect the tanks from the elements. The Contractor shall coordinate with the User and the Contracting officer in determining the capacity of LPG fuel required. The LPG fuel capacity shall be based on frequency of cooking, consumption of fuel every cooking cycle, frequency and availability of replacement fuel tanks and spare capacity. This project will require that the Contractor provide the agreed to amount of fuel tanks filled with LPG fuel at time of completion.

Provide chain link fence and gates around entire LPG storage facility. Fence shall match perimeter Force protection fence with lockable gates, and concertina wire etc.

6.12 WOOD COOKING STOVE – FOR OUTSIDE KITCHEN FACILITY ONLY

Provide a separate wood burning cooking stove kitchen annex building within the DFAC yard with commercial grade wood fired cooking stoves as indicated in the drawings. Provide a trench drain that extends the length of the cooking line-up for cleaning purposes. The cooking stove tops shall be accessible by stairs for walking on top of the stoves and the stove tops wide enough for a person to walk on. The hood height shall not interfere with a person standing on the stove top. The ceiling of the annex shall not be less than 3 meters high to allow smoke and/or heat to be ventilated outside of the building. This can be accomplished with exhaust fans and clerestory window designs.

This annex shall be separated from the main kitchen by a covered walkway.

Provide a covered wood storage area next to the annex which shall be secured and surrounded with fencing as to prevent pilfering. Gates and locks shall be provided as part of the security.

Stove shall be constructed out of fire bricks and topped with 5mm thick cast iron countertop. Route the chimney runs inside the building envelope (inside the heated space) so air and flue gases stay at least as warm as the air in the building until they are expelled outside. The minimum flue thickness shall be no less than 1.5mm black steel. The Contractor shall protect chimney by means of metal rails or masonry wall from damage from large pots during cooking. The chimney shall penetrate the highest part of the building envelope so the chimney functions better. The chimney shall rise at least 60 cm (24 inches) above the roof ridge and its top is clear of obstacles to wind flow so it can produce stable draft and it has a chimney (rain) cap because without one, any chimney is vulnerable to adverse wind pressures. The chimney flue shall be insulated and be the correct size for the appliance so flue gases are kept warm and flow quickly through the system. The flue pipe, if used, shall run straight up from the appliance to the chimney and the chimney has no offsets because each change in direction presents resistance to flow. The appliance and venting system shall be reasonably well-sealed to prevent leaks that introduce cool air and make the system more vulnerable to adverse pressures. The system shall be installed in a building that has a balanced ventilation system. There shall be high exhaust fan in the stove exhaust hood. The Wood stove kitchen shall be well vented with louvers located high at walls on the building ends. The wood feeding doors shall be located on the outside of the building. Contractor shall submit shop drawings for approval.

6.13 MECHANICAL REQUIREMENTS FOR GENERATORS

The following shall be provided for the Mechanical design and installation for the stationary generator sets and related mechanical systems with their interface with the facility. This includes, but not limited to, the following: Foundations, mountings, exhaust systems, cooling systems, ventilation, fuel systems, noise reduction, fire protection & safety, and equipment room configuration. See Electrical for power and electrical equipment requirements.

a. The generator set shall be the manufacturer's design for outdoor weatherproof installation with skid-mounted radiator. Weatherproof generator set shall be protected from the elements with a structural cover which extends over the bulk fuel storage tank.

b. For fuel and day tank requirements, see Plumbing paragraph, "GENERATOR FUEL STORAGE/DISTRIBUTION."

c. For fire emergencies, see Fire Protection paragraph, "PORTABLE FIRE EXTINGUISHERS."

d. Generator set facilities shall be oriented with the prevailing winds when possible (with the alternator upwind) to assist ventilation air flow across the alternator and engine and promote heat removal by the fan and radiator. Weather-proof generator sets shall be provided with a covered (roof-only) shelter enclosed with a chain link security fence for both the generator and fuel storage tank.

6.14 OPERATIONS AND MAINTENANCE (O&M) FOR MECHANICAL

a. The O&M manuals must be provided in the English language and prior to any training activities.

b. All control panels shall have tri-lingual name plates in Dari, Pashto and English.

c. The Contractor shall provide an outline of the training lesson plan (to be approved by the Government) prior to conducting training. CD recordings of training on video shall also be provided, after training is conducted.

6.15 PLUMBING

6.15.1 GENERAL

The Contractor shall construct domestic cold and hot water systems, waste, drain and vent systems, and storage and fuel-oil storage and distribution systems as indicated in the drawings. The Contractor shall be responsible for proper installation of all domestic and special plumbing systems required for full and safe operations in the Generator Plant, Water Storage and other facility or structures required in this contract.

The work covered in this scope also includes the delivery to site, erection, setting to work, adjusting, testing and balancing and handing over in full operating condition all of the plumbing equipment and associated plumbing works.

6.15.2 SUB-CONTRACTORS QUALIFICATIONS

The plumbing systems shall be executed by a plumbing specialist subcontractor experienced in the design and construction of these types of systems.

6.15.3 STANDARD PRODUCTS

All materials and equipment shall be standard product of a manufacturer regularly engaged in the manufacture of the product and shall duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening.

6.16 CODES, STANDARDS AND REGULATIONS

The design and installation of equipment, materials and work covered under the plumbing services shall conform to the following standards, codes and regulations where applicable except where otherwise indicated under particular clause(s). The publications to be taken into consideration shall be those of the most recent editions. Standards other than those mentioned herein may be accepted provided that the standards chosen are internationally recognized and meet the minimum requirements of the specified standards. The Contractor shall submit proof of equivalency if requested by the Contracting Officer.

IPC – International Plumbing Code

NFPA - National Fire Protection Association

ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers

ASME – American Society of Mechanical Engineers

ASTM – American Society for Testing and Materials

AWS – American Welding Society

6.17 PLUMBING SYSTEMS REQUIREMENTS

6.17.1 WATER

Domestic cold and hot water shall be provided in the facilities to serve the water usage and plumbing fixtures provided for the facility. Water service to each facility shall enter the building in a mechanical, toilet, storage, or similar type space. The building service line shall be provided with a shut off valve installed inside the mechanical room or similar spaces. Water piping shall not be installed in or under the concrete foundation except for the service line. All water piping shall be exposed and routed parallel to the building lines and tight to the walls and ceiling. Insulation shall be provided where required to control sweating of pipes or to provide protection from freezing. Electric heat trace cable for freeze protection shall not be provided as a substitute for space heating systems.

6.17.2 PIPING MATERIALS

Domestic cold water shall be distributed by means of standard weight (schedule 40) galvanized steel pipe. Domestic hot water shall be distributed by means of standard weight (schedule 40) galvanized steel pipe. Waste and vent piping can be made of either galvanized steel pipe (schedule 40), or Polyvinyl Vinyl Chloride (PVC) conforming to ASTM D 2665. Corrosion protection shall be provided if galvanized piping comes in contact with earth or masonry floors, walls or ceilings.

6.17.3 PLUMBING WATER FIXTURES

The following typical plumbing fixtures shall be provided:

a. Eastern Water Closet with flush tank assembly. Provide acid resisting fired porcelain enameled cast iron water closet complete with rotating No-Hub 'P' trap and No-Hub coupling to meet piping requirements. Eastern Style water closet shall be furnished with integral non-skid foot pads and bowl wash down non-splashing flushing rim. The water closet shall be completely self supporting requiring no external mounting hardware and shall be flush with floor. The Eastern Style water closet shall incorporate waterproofing membrane flashing flange. Provide a cold water spigot 300mm above finished floor on the right (from a perspective of standing inside of the cubicle and looking out) sidewall of the cubicle. Spigot shall have a flexible hose and spray nozzle such that the occupant can wash over the water closet. Toilets shall be oriented north and south. Toilets shall not face east or west.

b. Lavatories. All sinks shall be the trough type constructed of block and concrete with ceramic tile exterior and lining capable of withstanding abuse. Provide maintenance access to waste piping and P-traps from under the sink.

c. Sink Faucets. Faucets shall be chrome plated brass or bronze alloy with hot and cold water valves for manual mixing. Faucet handles shall be chrome plated brass or bronze alloy and non-lever type. **No goose neck faucet fixtures shall be used**.

d. Janitor’s Sink. Janitor sink shall be floor mounted and constructed out of concrete. Provide hot and cold water valves with manual mixing. Faucet handles shall chrome plated brass or bronze alloy. Include a stainless steel shelf and three mop holders.

e. Shower. Showerhead and faucet handles shall be chrome plated brass or bronze alloy. Provide hot and cold water valves for manual mixing. In addition to a shower head, provide each shower stall with a threaded faucet approximately 1.2 m AFF with hot and cold-water controls, mixing valve and a diverter type valve so water can be directed to either the shower or to the lower faucet. Shower shall be provided with low flow shower head. The shower head shall be heavy duty type and securely fastened to the wall.

f. Kitchen Sink. Two (2) compartment sink shall be corrosion resisting formed stainless steel. Faucet bodies and spout shall be chrome plated brass or bronze alloy. Handles, drain assembly, and stopper shall be corrosion resisting steel or brass/bronze alloy.

g. Ablution Trench. See building floor plans for size and construction of trench and number of stations. Provide trench drain with brass grating and strainer. Provide each station with hot and cold water valves with manual mixing. Faucet handles shall be copper alloy.

h. Grease Interceptor (Exterior only). Shall be constructed out of concrete, manual cleaning type with removable checker-plate cover complete with flow control valve. Tested and rated in accordance with PDI G-101. Concrete shall have a minimum compressive strength of 28 MPa (4060 psi) in 28 days (kitchen use only).

i. Floor Sink: Provide floor sink, circular or square, with 300mm overall width or diameter and 250mm nominal overall depth. They shall have acid resistant enamel interior with cast iron body, aluminum sediment bucket and perforated grate of cast iron. Outlet size as indicated on plans.

j. Floor or Shower Drain: Cast iron construction with galvanized body, integral seepage pan, and adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. Toilet room floor drains are similar except are provided with built-in, solid, hinged grate.

k. Trench Drains: Floor trench shall be concrete construction with a cast iron grate. The cast iron grate shall be sectionalized and hinged so that it can easily be opened to clean out the trench. Iron grates shall be fabricated in sections in length not greater than 1500 mm. The floor trench shall be provided with perforated aluminum pan inserts which can be removed to clean out large food particles. The floor trench drain shall be adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. This style of floor trench shall be installed in the kitchen area of the DFACs in response to kitchen cleaning practices of the local national staff.

l. Room hose bibs and floor drains shall be provided as required. Afghan dining facility kitchen area clean-up hose bib to be supplied with connecting hose on reel including approximately 12 meters of hose. Provide clean-up spray nozzle with hose assembly.

m. Provide P-Traps per International Plumbing Code IPC for all fixture drains, floor and trench drains, and shower drains. P-traps shall have minimum of 50 mm water seal.

n. Large Pot sink, provide clean-up spray nozzle with hose assembly.

6.17.4 HOT WATER

Hot water shall be provided for the facility to supply 49°C (120°F) hot water to fixtures and outlets requiring hot water. Hot water piping shall be routed parallel to the building lines and concealed within finished rooms. All hot water piping shall be insulated.

6.17.5 HOT WATER HEATERS

The hot water shall be generated by electric water heaters. The unit(s) shall be typically located inside a mechanical room, storage room, toilet/janitor room or similar type space and be wall-mounted or be floor-mounted on a 100 mm (4 inch) raised concrete pad. The unit(s) shall be of the commercially available tank type having low or medium watt density electric heating elements.

In cases where the pressure of the water coming into the tank will violate manufacturer recommendations, a pressure reducer shall be installed in the line before the water heater. Each water heater shall be equipped with a vacuum relief valve and temperature and pressure (T&P) relief valve that

discharge into a nearby floor drain; discharge piping shall terminate 50 mm (2 inches) above the floor drain. The discharge pipe shall not be installed horizontally along the floor to eliminate any tripping hazards. Multiple water heaters shall be connected by common inlet and outlet manifolds to ensure equal flow and drawdown rates.

6.18 WASTE, DRAIN AND VENT SYSTEM

Contractor shall install the waste, drain and vent system as shown on the drawings. The following is general guidance for the installation of the waste, drain and vent system. If there are any discrepancies between the drawings and the following narratives or the IPC, the Contractor shall notify the COR.

Floor drains shall be provided in each room that contains a water source. Floor drains shall be provided in the mechanical equipment and toilet rooms as required. Floor drains shall be provided next to the electric water heaters. In mechanical rooms, floor drains shall be provided to avoid running drain piping long distances above or over the floor. A trench drain shall be provided for the DFAC Kitchen. All waste and vent piping shall be provided in accordance with the latest edition of IPC. Drain outlet shall use p-trap system to trap sewer gases. P-trap drain should be a one-piece system without removable parts.

Every trap and trapped fixture shall be vented in accordance with the IPC. In order to minimize vent piping, consider incorporating circuit venting or combination drain and vent systems in accordance with Section 911 and 912 of the IPC.IPC Section 708.3 states that cleanouts be provided no more than 100 feet apart measured from the upstream entrance of the cleanout. AED standard is to provide cleanouts at 25 feet intervals due to the nature of Afghans plugging up the drains and the limitation of the cleanout routers available in Afghanistan.

6.18.1 GENERATOR FUEL STORAGE/DISTRIBUTION

Fuel Oil Storage and Distribution system shall be provided to support operation of diesel engine generator set(s) and tank(s) shall be protected from the weather by a structural cover.

The containment dike(s) shall be sized to contain 110% of the total fuel in a single largest tank, and the dike structure shall be constructed of reinforced concrete. Underground fuel piping shall be installed within a concrete secondary containment trench with removal covers and applied POL-resistant coating.

Fuel shall be transferred from the bulk storage tanks to the elevated day tanks by duplex-fuel pumps. Day tanks shall be installed within a concrete containment dike and store enough fuel to operate each generator set at full load for a 8-hour period. Elevated day tanks are preferred if the generator does not contain an integral pump.

Bulk storage tanks shall be complete with fill tube and cap, suction tube, tank gauge, vent, and other fittings and appurtenances required for full and safe operation. Tanks shall be provided with support saddles, platform/stair and concrete pad.

Tanks of 3,780 to 45,430 liters (1,000 to 12,000 gallons) capacity shall be provided with 760 mm (30 inch) diameter manways. . Tanks 3,780 liters (1,000 gallons) and larger shall be provided with a minimum of one (1) tank manway to allow for internal tank access. Piping will not penetrate through access manways. Tank shall be provided with a combination cleanout and gauge connection.

Vent pipe sizing shall be not less than 32 mm (1-1/4") nominal inside diameter Vent shall be the rupture disc type calibrated to burst at 14 kPa (2 psi) pressure, and operate at 80 percent of burst setting. Tank shall be provided with an overfill alarm system. Tank shall be provided with two (2) stick gauges graduated in m and mm. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored. Each storage tank shall be provided with an automatic analog reading gauge which is directly mounted to a tank's man way cover. Cathodic protection shall be provide for metal components in accordance with the manufacturer's recommendations. Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions. External platform/ladder access to tank top (i.e. manhole) shall be installed on a concrete pad.

A tightness test shall be performed on each above ground storage tank. The tests shall be performed prior to making piping connections. Tests shall be capable of detecting a 0.1 mL/s (0.0126 cu.ft/h) leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction. Each storage tank shall be pressurized with air to 35 kPa (5 psi) and monitored for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects. Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed. **The Contractor shall provide a full supply of fuel to each tank at the time of turnover to the Government.**

6.18.1.1 FILLING SYSTEM

A fuel filling system shall be provided for unloading fuel from fuel tanker into individual bulk storage tanks comprising of truck pad(s), duplex fuel transfer pumps, piping manifold and valves. The system shall provide remote fuel level monitoring panels at the pad(s).

6.18.2 VEHICLE REFUELING POINT

Fuel storage and distribution shall be provided to support the vehicles used at various locations on base. Diesel fuel shall be stored in one 22,712 liter (6,000 gallons) fuel tank and MOGAS shall be stored in one 22,712 liter (6,000 gallon) fuel tank. The generator diesel fuel and the vehicle fuel tanks shall all be within the same containment dike. The containment dike shall be sized to contain 110% of the largest volume of tank. Since all tanks are 22,712 liters, the containment dike shall be sized to hold 25,000 liters of fuel. Underground fuel piping shall be installed in a concrete secondary containment trench with removal covers and applied POL-resistant coating.

These tanks shall be complete with fill tube and cap, suction tube, tank gauge, vent, and other fittings and appurtenances required for full and safe operation. Tanks shall have overfill protection devices and remote overfill alarm. Tanks shall be provided with support saddles, platform/stair, concrete pad and leak spillage containment provisions. Fuels shall be transferred from the storage tanks by transfer pumps located within the fuel dispensing units. Fuel piping shall be fiberglass for underground and steel for piping located above grade. Dispensing unit shall be equipped with dual nozzles and key control. The fuel dispensing units shall be installed as shown on the attached drawings. Coordinate site design and route all contaminated drainage water from the fuel dispensing pad through an oil/water separator. Provide containment per applicable criteria.

6.19 TESTING AND COMMISSIONING

The Contractor shall test all piping systems in accordance with IPC International Plumbing Code. The final test shall include a smoke test for drainage and vent system and pressure test for the domestic water piping. After completing the work, the Contractor shall demonstrate that all plumbing systems operate to fully satisfy the function for which these systems have been designed. The Contractor shall test, adjust, balance and regulate the system and its controls as necessary until the required designed conditions are met. The Contractor shall include tests for interlocks, safety cutouts and other protective devices to demonstrate safe operation. All such tests shall be carried out in the presence of the Contracting Officer and full written records of the test data and final settings shall be submitted to the Contracting Officer. After all tests are complete, the entire domestic hot and cold water distribution system shall be disinfected. The system shall not be accepted until satisfactory bacteriological results have been obtained.

7.0 FIRE PROTECTION

7.1 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers shall be provided inside all facilities and at exterior locations as required in accordance with NFPA 10. Generally, extinguishers will be of the multi-purpose dry chemical type except for occupancies requiring a special type extinguisher (e.g., carbon dioxide portable fire extinguishers for electrical rooms).

8.0 ELECTRICAL

8.1 GENERAL DESIGN AND PRODUCT CRITERIA

8.1.1 DESIGN STANDARDS

- Calculations in the Design Analysis, at a minimum, shall include:
    - Voltage Drop for all feeders and one worst case branch circuit per feeder
    - Generator and Transformer Derating Calculations

- Conflicts between criteria and/or local standards shall be brought to the attention of the Contracting Officer for resolution. In such instances, all available information shall be furnished to the Contracting Officer for approval.

- All electrical systems and equipment shall be installed in accordance with the requirements set forth in the documents referenced herein.

- Acceptance test procedures on all systems provided. As a minimum the testing procedures shall comply with the requirements of the National Fire Protection Association (NFPA) and the International Electrical Testing Association (NETA).

- Electrical design shall be in the International System of Units (SI).

8.1.2 ELECTRICAL PRODUCTS/MATERIAL

Unless noted otherwise, all electrical material used shall be tested and marked by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL). In the event that NRTL-tested materials are not available, the Contractor may then select applicable IEC manufactured, and CE marked material but the Contractor shall prove equivalence and must provide the government with a full copy of the relevant specification(s)/standard(s). If IEC manufactured, CE marked material is chosen, the product shall be provided with a “Declaration of Conformity”. The “Declaration of Conformity” contains information to allow tracing of the product, including product identification, manufacturer’s name, address, signature and standards by which the product is tested. IEC manufactured, CE marked material shall also be independently certified by a “Notified Body.” A “Notified Body” must serve as an independent test lab and perform type-tests that comply with the applicable IEC standard. These tests shall be recorded in “Technical Documentation” by the laboratory and submitted for review.

Material and equipment installed under this contract shall be for the appropriate application and installed in accordance with manufacturers recommendations.

Equipment enclosure types shall be in compliance with the National Electrical Manufacturer's Association (NEMA) or the International Electro-Technical Committee (IEC) standards.

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a non-corrosive and non-heat sensitive plate, securely attached to

the equipment. All equipment delivered and placed in storage, prior to installation, shall be protected from the weather, humidity and temperature variation, dirt and dust, and any other contaminants. All equipment shall be in new condition, undamaged and unused.

All material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least two (2) years prior to bid opening.

8.2 SPECIFIC SYSTEM STANDARDS

8.2.1 GENERATOR POWER SYSTEM

Generators shall meet one of the following requirements:

- UL-2200 listed
- CSA certified (C22.2 No. 100-04 Class 4215-01)
- CE-marked AND BS5000 AND ISO 8528 AND ISO 3046 AND IEC 60034 AND VDE 0530 AND NEMA MG-1.

Generator diesel engines shall meet the requirements of NEMA MG-1 Part 22, Continuous Duty and a temperature rise of 105°C. Generators shall be rated for continuous duty at 100 percent of the power rating. Winding insulation shall be Class H and meet the requirements of UL 1146. The generator shall be provided with an electric start system and a 220V jacket heater. Generator engines shall be provided with a cool down relay with adjustable cool down time. The generator control panel shall be provided in accordance with NEMA ICS 6, enclosed and mounted on the engine/generator set with vibration isolation. Generator circuit breakers shall be listed per UL 489 listed or manufactured to BS/EN 60947 AND CE marked. The complete factory assembled generator shall be tested prior to shipment in accordance with IEEE 115, NEMA C 50 10, IEC 60034-2 and NEMA MG 1. Generators shall be provided with a weatherproof enclosure.

Generators shall be derated as necessary for the ambient temperature and altitude of the site. Derating calculations shall be provided in the design analysis, and shall be based on the generator manufacturer's recommendations.

For fuel storage requirements and capacity, see Mechanical paragraph: Generator Fuel Storage/Distribution.

8.2.2 ELECTRICAL DISTRIBUTION SYSTEM

Underground distribution systems, if applicable, shall be in concrete encased schedule 40 PVC duct banks under roadways, parking lots and heavy traffic areas, and direct buried Schedule 80 PVC duct banks in other areas. Underground ducts shall be not less than 100mm diameter and not less than 1220mm below grade. Manholes and hand holes shall be provided at changes of direction of more than 40 degrees and elsewhere as required to limit the pulling tension and sidewall pressure on the cables during installation to acceptable levels as defined by the cable manufacturer. Manholes shall be provided for duct banks with more than 2 ducts. Hand holes shall be provided wherever a manhole is not required by quantity of ducts or by cable manufacturer's installation recommendations.

The system shall be configured as a loop system and the feeders shall be provided with tie capabilities through the use of pad mounted load-break switches. "T-tap" style splices shall not be allowed in manholes.

8.2.2.1 PANEL BOARDS

Panel boards shall meet one of the following requirements:

- UL67 listed
- Tested and Marked by another NRTL

- BS/EN 60439 or IEC 60439-manufactured, AND type-tested assembly (TTA)

All panel boards shall be circuit breaker 'bolt-on' type panels.

Enclosures for exterior and interior applications shall be NEMA Type 3 (IEC Classification IP54) and NEMA Type 1 (IEC Classification IP10) respectively.

Circuit breakers shall be connected to copper bus bars within the panel boards. Daisy chain (breaker-to-breaker) connection(s) made with conductor or interconnecting bus bar are not acceptable. A 3-pole circuit breaker shall be a single unit and not made up of 3 single pole circuit breakers connected with a wire or bridge to make a 3-pole breaker.

For large panels (225 Ampere and above) provide an ammeter, voltmeter and kilowatt-hour meter to monitor energy usage. Selector switches shall be provided for each meter to read all 3 phases.

All panel boards shall be surface mounted. All panels shall be provided with a minimum of 25% spare capacity for future load growth.

All panel boards shall be provided with a nameplate including the following information:

- Manufacturer's Name or trade mark
- Type designation or identification number, or other means of identification making it possible to obtain relevant information from the manufacturer
- Mark of the NRTL (such as UL), IEC 60439-1, or BS/EN 60439-1
- Rated current, operational voltage, and impulse withstand voltage
- Short-circuit withstand strength
- Degree of Protection

All panel boards and load centers shall be provided with a panel schedule. All circuit breakers shall be labeled with an identification number corresponding to the panel schedule. Panel Schedule shall be typed written in English, Dari and Pashto. The panel schedule shall identify the conductor color code present in the panel.

Any building with any branch circuit breakers larger than 32A, 3 pole shall have at least one distribution panel for the larger breakers.

8.2.2.2 CIRCUIT BREAKERS

Circuit breakers shall meet one of the following requirements:

- UL 489 listed
- Tested and marked by another NRTL
- BS/EN 60947 or IEC 60947-manufactured
- BS/EN 60898 or IEC 60898-manufactured

Circuit breakers shall not be rated less than 15-amperes. All Breakers feeding wet areas shall be Residual Current Breakers w/ Overload (RCBO), Ground Fault Protector (GFP), or Ground Fault Circuit Interrupter (GFCI).

8.2.3 INTERIOR DISTRIBUTION SYSTEM

Contractor shall design and provide circuits for all mechanical equipment and any other equipment that requires power and make the final connections.

8.2.3.1 CONDUCTORS

All cable and wire conductors shall be copper. Conductors shall be single core; multi-conductor cables shall not be used. All wiring, unless noted otherwise, shall be conductor-in-conduit. Conductor jacket or insulation shall be color coded to satisfy IEC requirements. For a three-phase system, phase A shall be

brown, phase B shall be black, phase C shall be grey, the neutral shall be blue and the ground shall be green/yellow. Conductor color coding shall be identified on the plans. If a new feeder is added to an existing panel board, colored electrical tape shall be used on the new conductors to match the existing color code. The grounded (neutral) conductor shall be permanently identified by a tag, label, or marking at the interface with an "N" on both the old and new grounded (neutral) conductor. The use of 75 or 90 degree C (minimum) terminals and insulated conductors is required. Use of higher degree C rated conductors on circuits with protective device terminals rated at a lower degree C is allowed but must be derated to the rating of the device terminals.

Aluminum conductors shall not be specified or used except as bare steel reinforced (ACSR) overhead conductors in an aerial primary distribution system.

All branch circuit wiring shall be copper, minimum #4 mm^2 (#12 AWG) installed in metal conduit.

Conductors shall be sized in accordance with the AED Design Requirement entitled "Breaker and Conductor Sizing." Manufacturer-provided ampacity charts shall not be used in determining conductor size.

Voltage Drop for branch circuits shall be limited to no more than 3%; voltage drop for branch and feeder circuits combined shall be limited to no more than 5%.

8.2.3.2 CONDUIT

Metal conduit (EMT) system shall be complete, to include but not limited to, necessary junction and pull boxes for all surface mounted conduit systems. Surface-mounted Nonmetallic Raceways shall not be allowed. Smallest conduit size shall be no less than 20mm (0.75 inch) in diameter. All empty conduits shall be furnished with pull wire or cord or rope (depending on the size of conduit and length of run). Exterior conductors below grade shall be installed in concrete encased PVC conduit at a depth of 1220 millimeters.

Conduit shall be surface mounted in all areas.

8.2.3.3 RECEPTACLES

Receptacles shall not be provided in latrines, bathrooms, restrooms, ablution areas, or shower rooms.

Receptacles (outlets) shall be duplex type 16A, 230V, 50 hertz, type CEE 7/7 (Schuko) with Earth Ground.

8.2.4 LIGHTING

Indoor lighting for all areas shall consist of fluorescent surface mounted light fixtures. Exterior lighting shall be HID (metal halide or high pressure sodium) as referenced. Moisture resistant/waterproof (IPx4 rated or better) fluorescent light fixtures shall be provided in high humidity and wet areas such as latrines, showers and outside. Battery powered 'emergency' and 'exit' lights shall be provided within each building, as applicable, for safe egress during a power outage. All light fixtures shall be factory finished, complete and operational, to include but not be limited to, lens, globe, lamp, ballast etc. Industrial type fluorescent light fixtures shall not be used. Every room shall be provided with a minimum of one light switch. Light fixtures shall be mounted approximately 2.5-meters (8 feet) above finished floor (AFF) minimum. Fixtures may be pendant or ceiling mounted, depending on the ceiling type and height.

Lighting in large rooms/areas may be controlled from multiple switches. Three-way or four-way lighting shall be provided in all rooms / areas with multiple entrances.

Above mirror lights shall be provided in toilet rooms. Above-mirror lights shall be IPx4 rated if within Zone 2 as identified in BS7671.

8.2.4.1 EMERGENCY LIGHTING

Fixtures shall be provided with self-contained nickel cadmium battery pack to operate on stand-by circuit for 90-minute minimum. Unit shall have test/re-set button and failure indication lamp.

Emergency light fixtures shall be UL 924 listed, marked/tested by another NRTL, or IEC 60598 manufactured.

8.2.4.2 LIGHT FIXTURES

Lighting fixtures shall be a standard manufacturer's product. Fluorescent surface mounted light fixtures shall be power factor corrected and equipped with standard electronic ballast(s). Fixtures in medical facilities shall also have electronic ballasts. All light fixtures shall properly operate using standard lamps available locally. Fixtures shall be fully factory wired and designed for appropriate application i.e. appropriate for that location where installed.

8.2.4.3 ILLUMINATED EXIT SIGNS (EXIT LIGHTS)

Fixtures shall be single or double sided as required by the location and for wall/ceiling mounting. Unit shall illuminate continuously and be provided with self-contained nickel cadmium battery pack, to operate on floated-battery or trickle charge circuit. Fixture shall operate satisfactorily for 90 minutes during a power outage. Unit shall have test/reset button and failure indication lamp. Lettering "EXIT" shall be color red and not less than 6 inches (150 mm) in height and on matte white background. Illuminations shall be with LEDs.

8.2.4.4 SEARCH LIGHTS

- Prison grade
- Nickel reflectors (bullet resistant)
- 65 million candlepower (1000 watts)
- Manual operation from below with one hand
- Xenon lamp
- Weatherproof design

Search light shall be bonded to lightning protection system.

8.2.5 SINGLE LINE DIAGRAM

Complete single line diagrams shall be provided for all systems installed. All major items in each system shall be identified and labeled for respective ratings. Single line diagrams for each system, installed in a clear plastic frame, shall be provided.

8.2.6 SURGE PROTECTIVE DEVICES (SPD'S)

Transient Voltage Surge Suppression shall be provided utilizing surge arresters to protect sensitive and critical equipment. As a minimum TVSS protection shall be provided at each panel serving electronic loads and shall be shown on the panel schedule. It is recommended that Metal Oxide Varistor (MOV) technology be used for such applications.

8.2.7 GROUNDING AND BONDING

Grounding and bonding shall comply with the requirements of BS7671 for 50Hz systems and NFPA 70 for 60Hz systems. All raceways shall include insulated equipment grounding conductor (protective earth conductor), and grounding electrodes (earthing) shall be installed at every building or structure. Grounding electrodes shall include, at a minimum: concrete encased electrode, bond to building steel (if

available), bond to metallic water pipe (if available), and ground rod(s). Underground connections shall be exothermally welded. All exposed non-current carrying metallic parts of electrical equipment in the electrical system shall be grounded. Final measurement of the ground resistance shall not exceed 25 ohms when measured more than 48 hours after rainfall.

Ground rods shall be copper clad steel, with minimum diameter of 17.2mm and minimum length of 3000mm.

8.2.8 LIGHTNING PROTECTION SYSTEM

The Contractor shall install Lightning Protection Systems where shown on the site-adapt plans, and install IAW NFPA 780.

8.2.9 FIRE DETECTION & ALARM SYSTEM

Fire Detection and Alarm System(s) shall be provided where shown on the site-adapt plans and installed in accordance with NFPA 72 requirements. System shall include, but is not limited to, Fire Alarm Control Panel (FACP), manual pull stations, horns, strobes, and smoke and/or heat detectors (with alarm verification feature). At a minimum, all sleeping rooms shall have single-station smoke alarms that are line-voltage powered with battery backup. The system shall be capable of automatically transmitting the alarm signal, via telephone lines, to the local fire department/fire station or other location designated by the Contracting Officer. Fire alarm system shall be complete and a standard product of one manufacturer. The fire alarm system shall either be UL listed AND FM approved or European standard “EN 54” certified AND CE marked. Fire alarm system shall be tested and approved/certified by a third-party body.

-END OF SECTION-

SECTION 01040

SECURITY

1.0 SPECIFIC CONTRACT SECURITY ASSESSMENT

The Government has determined that there is a Moderate Risk associated with the security environment in which this work is to be performed. This rating takes into consideration the geographic location of the work, including the Government's institutional knowledge of the recent history of this area as it relates to security, and the nature of the work to be performed under this contract. As such, the approval of your plan to provide security throughout the period of performance of this contract will be carefully reviewed by the Source Selection Evaluation Board, and will be weighted appropriately for the level of risk described above.

The Government is entitled to assume that the Contractor possesses the degree of knowledge that is "standard" to experienced contractors in this industry and location, and that the Contractor shall gain other relevant information that is reasonably available about the (contract/task order) to be performed. The Government is further entitled to assume that the Contractor understands its abilities as they relate to the work to be performed under the contract.

2.0 GENERAL BACKGROUND

Operations in Afghanistan require Armed Contractors (ACs) and Private Security Companies (PSCs) to fulfill a variety of important security functions for the Department of Defense (DOD), Department of State (DOS), and other entities operating in the Combined Joint Operations Area – Afghanistan (CJOA-A). Included in these ACs and PSCs are traditional private security companies, the Afghan security guards, and DOD contractors who are armed for personal protection. Traditional PSCs perform convoy escort, static security, and personal security details (PSDs). Afghan security guards (ASGs) provide local static security to Forward Operating Bases (FOBs), Company Operating Bases (COPs), and other infrastructure with local Afghan companies. DOD contractors may be armed either as a function of the service they provide or their operating location. These AC/PSCs are not combatants; they execute services to protect personnel, supplies and equipment, and fixed facilities. Weapons employed by AC/PSCs are for purely defensive purposes only. This section is in accordance with the "USCENTCOM Policy and Delegation of Authority for Personal Protection and Contract Security Service Arming of DOD Civilian Personnel and Contractors for Iraq and Afghanistan", 7 November 2006.

The intent of these contracted services is to "free" joint forces to conduct military operations and other inherently governmental functions. As the CJOA-A experiences both building of combat power as well as the parallel civilian uplift effort, the reliance on contracted services to include AC/PSCs is likely to increase. AC/PSC services are necessary to secure installations and other infrastructure, conduct movement support for sustainment, train Afghan Forces to proficiency, and transport key personnel throughout the CJOA-A. The terms armed contractor, private security company, or contractor personnel, includes all personnel directly employed by the Contractor at any tier of contract or subcontract. This section applies to all armed contractors providing service on DOD contracts.

3.0 GOVERNMENT REPRESENTATIVES

USACE will have a hierarchical security organization that disseminates essential security information and provides consistent and comprehensive use of security information. The USACE Area OIC/NCOIC will serve as the Area Office security officer and the Resident OIC/NCOIC will serve as the security officer at each Resident Office. When required the Area Office will request security plan review support from the Anti-Terrorism/Force Protection (AT/FP) expertise in the District Joint Operations Center (JOC). The Contractor may request this support from the Area/Resident Office OIC.

3.1 SECURITY PLAN

The security officers will review and approve all current and future contractor security plans prior to submittal approval by the authorized representative of the contracting officer. The security officer shall ensure that all contractor security plans are in accordance with the contract requirements. The security plans shall address movement of contractor labor, material, and equipment including contractor notification requirements to Government security officers who will in-turn inform Task Force Commanders and other Coalition Forces. The security officers will lead the quality assurance program to ensure contractors are executing their approved security plans. The Government will not allow the Contractor to start work without an approved security plan.

3.2 SECURITY COORDINATION

Contractor shall be required to coordinate construction site security with Task Force or Provincial Reconstruction Team (PRT) Commanders. Afghan or Coalition Forces may be available, under certain circumstances, to assist the Contractor on a case by case basis. The Government also expects the Contractor to coordinate with local Afghan Forces to the greatest extent possible. Coordination does NOT include nor imply making payments of any nature whatsoever to the local ANA/ANP or Local/Provincial Government Officials for permission or protection to construct the project. The Contractor shall immediately inform the Government if asked to make any such payments, and the Government will provide further direction to the Contractor. Corruption will not be tolerated at any level, under any circumstances. Conducting business in this manner will be grounds for termination of the contract.

3.3 CLAIM FOR SECURITY DELAYS

Following a threat or an attack on a USACE contractor or a contractor claim for security delays, the security officer will validate the incident and assess the incident's impact to the contract period of performance. Within 30 days of the incident, if the Contractor submits a request for an extension of time, the Government ACO will assess the incident's impact to the construction schedule and as necessary issue a contract modification for additional non-compensable time.

3.4 SECURITY RATING

Each contract/task order will be assigned a rating by the Government security officer (see paragraph 1.0). This rating will determine the level of approval for the security plan. Assistance from the District's JOC AT/FP expertise may be required to assess the rating. Ratings and approval levels are below:

a. Extremely High Risk: District Commander

b. High Risk: Deputy CDR, Chief of E&C, Area OIC, or J3 OIC

c. Moderate Risk: Chief of Construction, Area OIC/NCOIC, or Area Engineer

d. Low Risk: Resident OIC/NCIOC, Resident Engineer

3.5 GOVERNMENT PROVIDED SECURITY

Any U.S. Government provided security/escort services will be in accordance with DFAR 252.225-7040 CONTRACTOR PERSONNEL AUTHORIZED TO ACCOMPANY U.S. ARMED FORCES DEPLOYED OUTSIDE THE UNITED STATES (JUN 2006).

4.0 SITE SECURITY FOR PROJECTS OUTSIDE OF ACTIVE COALITION FORCE BASES

The Contractor shall develop a site security plan and program (IAW Security Plan Section) to provide 24 hr/7 days a week security for the project throughout the performance of the Contract. There will be armed guards manning project watch towers, the main entry gate, and roving patrols of the compound, adjacent hills, and observation posts at all times. Tower guards will maintain perimeter security to include thwarting any attempted theft, vandalism, or attacks. Roving guards will patrol vehicle staging areas making sure unauthorized personnel are not present, and prevent damage or sabotage of grounds and/or equipment. Roving patrols will also check nearby hills to prevent snipers or any other terrorist activity that might threaten the site. Facility security shall include access control to limit entry to unauthorized personnel, conduct vehicle and personnel bomb searches, report suspicious persons, question persons as required, and respond to calls for security support and assistance. The Contractor shall employ culturally appropriate means of searching personnel. Local governments, ANA/ANP units, and Coalition Forces should be coordinated with to support the large scale security of the site to the greatest extent possible; however, the Contractor is ultimately responsible for providing security. Coordination does NOT include nor imply making payments of any nature whatsoever to the local ANA/ANP or Local/Provincial Government Officials for permission or protection to construct the project. The Contractor shall immediately inform the Government if asked to make any such payments, and the Government will provide further direction to the Contractor. Corruption will not be tolerated at any level, under any circumstances. Conducting business in this manner will be grounds for termination of the contract. The Contractor is expected to perform all required actions to protect the construction site compound from theft and vandalism and personnel from physical harm. These measures are strictly for the protection and defense of the on-site people and property; contractors are not authorized to conduct any type of offensive operations. For security of road construction, transportation of supplies, and equipment convoys, see the appropriate section below.

4.1 SITE SECURITY FOR PROJECTS ON-BASE

The Contractor shall provide general perimeter force protection security for developing the site. Security may include but is not limited to temporary fences and private security guards. Perimeter security shall prevent unauthorized site access and provide site protection to the Contractor's work force and the Government personnel for the duration of the project. Many bases in Afghanistan have multiple contractors and local Afghan security forces working on them; it is the responsibility of the Contractor to ensure the 24/7 protection of the construction site from vandalism and theft. If the security situation request measures more than the general provision specified by the Contractor, the Contractor shall inform the Government immediately. The Contractor has the ultimate responsibility for all security measures. These measures are strictly for the protection and defense of the on-site people and property; Contractors are not authorized to conduct offensive operations.

4.2 SECURITY FOR ROAD PROJECTS, TRANSPORTATION, & CONVOYS

Road construction projects will maintain at least two armed traffic control points (TCPs) at 300 meters in both directions of the road, or at a distance that terrain dictates. TCP guards will thoroughly inspect vehicles, entering the compound for explosives, contraband, and unauthorized personnel. TCP guards will also check for proper identification and conduct physical searches of personnel entering and leaving the site. They will report suspicious persons, question persons as required, and respond to calls for security support assistance. The TCP must have controlling barricades to slow traffic in both directions, but not to block the road completely. The Contractor shall employ culturally appropriate means of searching personnel. The TCP must have a vehicle ready for immediate evacuation or pursuit of AAF trying to access the construction site.

4.2.1 MOVEMENT OF PROJECT EQUIPMENT AND SUPPLIES

The Contractor shall inform the Government no later than 72 hours before any movement of project equipment and supplies outside of any Coalition Force bases in the CJOA-A. Both the Government and the Contractor shall be aware of information security, using face-to-face meetings, courier mail, or other

secure means of communication to discuss movements. All contractor convoys will have a minimum of two armed security details in the front and rear of the convoy. Convoys longer than three vehicles will also have a center armed security detail. The minimum security detail is a vehicle(s) with two armed security personnel, each with AK-47 or equivalent weapons. While the aforementioned is a minimum requirement, the Contractor shall have an armed security detail commiserate with the threat of the route. The threat of attack in Afghanistan is very real, and Contractors must be prepared for violent ambushes from Anti-Afghanistan Forces (AAF). Redundant communication equipment is highly recommended using cell phone, satellite phone, or other Contractor/Government supplied communication/tracking equipment.

4.2.2 SECURITY DETAIL

The project site will also have a security detail on either side of the on-site construction. These details must be able to protect and defend from nearby buildings, hilltops, and concealed terrain while still providing immediate on-site security to the construction equipment and personnel.

4.2.3 REQUIRED TRAINING

The Government recommends the Contractor employ personnel that are trained in finding mines and improvised explosive devices along the construction route. Contractor personnel are prohibited from getting close, touching, or handling any explosive devices or unexploded ordinance found. The Contractor shall report the location of any of these devices to the Government security officer or local Afghan Forces immediately for disposal/removal.

5.0 SECURITY PLAN

During the Preconstruction Conference, the Contractor shall receive the Government's Alignment, Movement, & Security Plan (AMSP). The AMSP will have at a minimum:

a. An estimated threat assessment of the project area and major supply routes.

b. The contact information for the USACE security officers, engineering/construction representatives, local Coalition Forces, and local Afghan Forces near the project site.

c. General emergency procedures and critical information required for Coalition/Afghan Force security assistance.

d. The estimated number of quality assurance (QA) site visits by the Government on a weekly/monthly basis.

e. Any special security requirements directed by the Coalition Force Commanders in the area.

5.1 ESTIMATED THREAT ASSESSMENT

The Contractor is expected to develop a site security plan to cover a range of security operations from low to high threat. Included in this plan will be the capability for a surge of manpower and equipment required during high threat conditions. The Contractor is expected to notify all on-site personnel of increased threats and protective action to take.

5.2 SECURITY PLAN REQUIREMENTS

The security plan introduction must contain the following information at a minimum: MOI license number, AISA licensed (Yes/No), armed contractor & subcontractor company names, contract number/title, contracting agency (USACE-AED), type of work, number/type of weapons authorized, POC for company with contact details, Government Contracting Officer and COR with contact details, number of security personnel by type (U.S., Afghan, Other), company's country of registration/origin.

5.3 PERSONNEL

The plan shall contain the names, photos, and tazkira numbers of security personnel, those personnel with access to weapons/ammo and those persons who will be handling or transporting explosives. As part of the security plan, the Contractor shall continually submit the coordinates of the Contractor's base camps, quarries, and current work locations. The Contractor shall submit, prior to the commencement of construction, a plan for security protection, with a list of the chain of command or a letter of commitment from a licensed security contractor. Perimeter security shall prevent unauthorized site access and provide safety protection to the Contractor work force and government personnel for the duration of the project. The Contractor is solely responsible for security however local police shall be coordinated with regarding security to the greatest extent possible. Coordination does NOT include nor imply making payments of any nature whatsoever to the local ANA/ANP or Local/Provincial Government Officials for permission or protection to construct the project. The Contractor shall immediately inform the Government if asked to make any such payments, and the Government will provide further direction to the Contractor. Corruption will not be tolerated at any level, under any circumstances. Conducting business in this way will be grounds for termination of the contract. Additionally, our new contracts are going to require that ALL security personnel are to be registered biometrically.

5.4 FORCE PROTECTION CONDITION LEVELS

The Contractor shall use at least four force protection condition levels (Extremely High, High, Moderate, Low) with corresponding levels and codes for on-site threat postures (uniforms, weapons, and vehicle movements). The Contractor shall use road movement safety restriction codes (Green, Amber, Red, or Black) for frequently traveled roads in the vicinity of project site. Force protection conditions and vehicle route status will be publicized to the site population. As a guideline, here are the Coalition Force route status codes:

a. Green – Route Open; no restrictions.

b. Amber – Route Open; only mission essential travel allowed on this route; the Government Security Officer must approve all Contractor movements.

c. Red – Route Open; requires Commander's approval for travel. Forces are required to use armored vehicles; all non-essential ground site visits suspended.

d. Black – Route Closed to Coalition Forces except for emergency travel.

5.5 COORDINATION WITH LOCAL POLICE

The Contractor shall establish a threat assessment group with local police to determine local area threats and adjust force protection conditions as required. The Contractor shall use language assistants/interpreters if there is a language difference between the armed security personnel, the Contractor project manager, and other on-site personnel.

5.6 SECURITY PLAN SUBMITTAL REQUIREMENTS

Contractors will submit security plans in accordance with contract Section 01335 – Submittal Procedures for Projects.

6.0 ARMING LICENSE

Contractor personnel who are armed will be properly authorized to carry arms in Afghanistan by registering and obtaining a license to carry arms from the Afghanistan Ministry of the Interior through

USFOR-A. Armed contractor personnel must be properly trained and qualified on each weapon they will be authorized to use. Exceptions to proceed without a valid MOI license may be granted in rare cases at the sole discretion of the Government. Failure to obtain this license is grounds for contract termination. All armed contractors must carry a copy of their Letter of Authorization (LOA) and their MOI license at all times. U.S. and Coalition Forces have the right to ask for this documentation at any time.

7.0 LOCAL HIRE VETTING PROGRAM

The Contractor shall maintain a local hire vetting program for all local hires required under performance of this contract, to include background checks. The Contractor shall conduct interviews and review employment application information for their candidates, with results of the interview and information reviews provided to the USACE security representative for appropriate action. The Contractor shall be available to accept reports of threats and intimidations, and forward these to the appropriate Government agency for resolution. The Contractor shall demonstrate an awareness of cultural nuances (i.e. tribal relationships, etc.) and employ culturally sensitive measures when conducting interviews. The U.S. Government will enter all AC/PSC personnel into the nation-wide Biometrics network to verify Contractor vetting.

8.0 COMMUNICATION

The Contractor shall operate a 24/7 security operations center with communication capability to each guard on duty and the ability to notify all on-site personnel of increased threats and protective actions to take. The operations center will also have 24/7 communication with the local Coalition, ANA, or ANP security forces. The Contractor shall have communication with the District JOC at all times for rapid emergency response; the Government Security Officer will give the Contractor the JOC contact information. Communication can be via cell phone, email, satellite phones, VHF, HF, CODAN, text, or other communication technologies compatible with the Government's capabilities. The Contractor shall provide the Government with their contact information (names, numbers, frequencies, email addresses, transponder IDs, etc.) for the site encompassing all available communication means.

9.0 CONTRACTOR PROVIDED EQUIPMENT

The Contractor shall provide the operational security equipment including but not limited to weapons, radios, uniforms, vehicles, vehicle fuel, phones, and other equipment as proposed by the Contractor to provide complete site security.

10.0 TRAINING

The Contractor shall develop a training plan for each aspect of the security operations to ensure all employees receive initial and quarterly training to maintain certification, proficiency, and safety. Records of the training is an inspectable item for the COR and Security Officer. The Contractor shall ensure all security personnel are trained on the required COMISAF/USFOR-A Tactical Directive, ROE/RUF, escalation of force (EOF), withdrawal/clear drills, proportionality, target discrimination, positive ID, Law of War, small unit tactics training, and general convoy drills like vehicle recovery. This training will also include but not limited to weapons qualification, vehicle operations, IED, site security, traffic/entry control points, and safety. The Contractor shall provide a sufficient number of trained personnel to meet the required security level for the project beginning on the date of mobilization.

11.0 KEY CONTROL

The Contractor shall establish and implement methods in writing to ensure that all keys issued by the Contractor are not lost or misplaced and are not used by unauthorized persons. The Contractor shall develop procedures covering key control that will be included in their quality control system (See Section

01451). The project managers will keep a master log of all keys and provide a copy to the contracting officer's representative (COR) for verification. If a key is lost or stolen, the Contractor shall pay to have all impacted locks changed/rekeyed immediately.

12.0 SAFETY BARRICADES

Barricades shall be required whenever safe public access to paved areas such as roads, parking areas, or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Travel to and from the project site shall be restricted to a route approved by the Government site supervisor. As the situation dictates, one security guard will be posted at each safety barricade.

13.0 RESPONSIBILITY FOR PHYSICAL SECURITY

Prior to mobilization, the Contractor shall submit his proposed means of providing project physical security to prevent unauthorized access to equipment, facilities, materials and documents, and to safeguard them against sabotage, damage, and theft. The Contractor shall be responsible for physical security of all materials, supplies, and equipment of every description, including property which may be Government-furnished or owned, for all areas occupied jointly by the Contractor and the Government, as well as for all work performed. Security may include but is not limited to fence and private security guards. The Contractor shall provide perimeter force protection security for the developing site. The plan shall address in detail the Contractors proposed procedures, and organization necessary to produce and maintain effective security within the contract limits twenty-four (24) hours a day seven (7) days a week. This document shall be referred to as part of the security plan submittal.

14.0 CRITICAL INFORMATION TO REPORT

The Government is responsible for the management and oversight of DOD Contracted AC/PSCs delivering services throughout the CJOA-A. Given the impact of either contractor misbehavior or catastrophic attacks against contractors, it is critical that information regarding AC/PSC incidents is communicated quickly and accurately to the Government for purposes of management, fact-finding, and mitigation where necessary. The Government must receive the information addressed below. The Contractor shall report any of these information requirements immediately to the Government site supervisor:

a. AC/PSC Escalation of Force to include the use of weapons resulting in the death or injury of an Afghan citizen, coalition, or U.S. service member, other government official, or contractor.

b. AC/PSC accidents, traffic, or otherwise, resulting in the death or injury of an Afghan citizen, coalition, or U.S. service member, governmental official, or contractor.

c. Attacks against AC/PSC activities by Anti-Afghan Forces resulting in the death or injury of an Afghan citizen, coalition or US service member, governmental official, or contractor.

d. Reports of "lost convoys." These are AC/PSC escort or independent activities which have lost contact with their companies.

e. AC/PSC Escalation of Force, accidents, or other activities that result in significant damage to Afghan or USG vehicles, materials or facilities.

f. Anti-Afghan Force actions including small arms fires (SAF), RPG fire, indirect fire (IDF), improvised explosive devices (IEDs), and/or complex attacks against AC/PSC activities.

g. Contractor accidental or negligent discharge of a weapon.

15.0 REOCCURRING REPORTS

Every month the Contractor shall report the following to the designated contract security officer:

a. The number, type, and general description of every weapons discharge by the Contractor or any tier of subcontractor on the project.

b. The name of the Contractor's security manager and the total number of armed personnel working on the project.

c. The total number by type/caliber of all weapons employed on the project.

d. The serial numbers and license plates of all armored vehicles used for the project.

e. The type of transponder/tracking system used for any moving equipment used for the project.

f. Any changes made to security personnel (new hires, employees who quit or were let go, transfers, etc.).

g. Biometric registration of all new personnel.

16.0 CONTRACTOR SECURITY PERSONNEL REQUIREMENTS

The Contractor shall submit the names of all employees who will be working in security positions prior to their performance of any such work on this contract. All security personnel will be subject to Biometrics (retinal scan) testing by representatives of the Contracting Officer, at any time during performance of work on the contract. The names of security personnel and the Biometrics testing results will be vetted with the Afghanistan government, International Security Assistance Forces (ISAF), or U.S. Forces-Afghanistan to determine if any of the proposed security personnel are on the list of enemy combatants compiled by these sources. If the Contractor is notified by the Contracting Officer that such security personnel are on any of these lists of enemy combatants, such employees must be immediately removed from work on this contract. Repeated incidents of hiring security personnel on any of the lists of enemy combatants will be grounds for terminating the contract for default.

-- END OF SECTION --

SECTION 01060

SPECIAL REQUIREMENTS

1. GENERAL

1.1 PRECONSTRUCTION CONFERENCE

1.1.1 SCHEDULE OF MEETING

At the earliest practicable time, prior to commencement of the work, the Contractor and any Subcontractors whose presence is necessary or requested, shall meet in conference with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to the details of the administration and execution of this contract. This will include but not necessarily be limited to the Contractor's Quality Control (CQC) Program, the Contractors Accident Prevention Program, submittals, correspondence, schedule, access to the work site, security requirements, interface requirements, temporary facilities and services, hazards and risks, working after normal hours or on weekends or holidays, assignment of inspectors, representations, special requirements, phasing, and other aspects of this project that warrant clarification and understanding.

1.1.2 MEETING MINUTES

It shall be the responsibility of the Contractors CQC System Manager to prepare detailed minutes of this meeting and submit those minutes to the Contracting Officer for approval within three (3) workdays. Any corrections deemed necessary by the Contracting Officer shall be incorporated and resubmitted within two (2) calendar days after receipt. Upon approval of the minutes by the Contracting Officer, the Contractor shall distribute the minutes to all parties present or concerned.

1.2 AREA USE PLAN

The Contractor shall submit to the Contracting Officer - within seven (7) calendar days after NTP - an Area Use Plan designating intended use of all areas within the project boundaries (it should be delivered with other pre-construction documents, APP, QCP, etc.). This plan shall include, but not necessarily be limited to the following: the proposed location and dimensions of any area to be fenced and used by the Contractor; construction plant and building installations/the number of trailers and facilities to be used; avenues of ingress/egress to the fenced areas and details of the fence installation; drawings showing temporary electrical installations; temporary water and sewage disposal installations; material storage areas; hazardous storage areas. Any areas that may have to be graveled shall also be identified. The plan shall also include a narrative description of the building structural system, the site utility system and the office or administration facilities. The Contractor shall also indicate if the use of a supplemental or other staging area is desired. The Contractor shall not begin construction of the mobilization facilities prior to approval by the Contracting Officer of the Area Use Plan described herein.

1.3 CONTRACTOR'S MOBILIZATION AREA

The Contractor shall be permitted to use an area approved by the Contracting Officer within the contract limits for operation of his construction equipment and plants, shops, warehouses, and offices. Utilities will be provided for the Contractor as described below. The Contractor is responsible for obtaining any required additional mobilization area above that designated. The construction site shall be cleared of construction debris and other materials and the area restored to its final grade.

1.3.1 CONTRACTOR'S TEMPORARY FACILITIES

1.3.1.1 GENERAL

All facilities within the Contractor's mobilization area shall be of substantial construction suitable for the local weather conditions. Sanitary facilities shall meet the requirements of Corps of Engineers, Safety and Health Requirements Manual EM 385-1-1. Local nationals will not be granted any privileges under this contract. Government provided services are for American and Foreign national contractors only.

1.3.1.2 ADMINISTRATIVE FIELD OFFICES

The Contractor may provide and maintain administrative field office facilities within the mobilization area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

1.3.1.3 STORAGE AREA

The Contractor shall construct a temporary 1.8 meter (6 foot) high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green or brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless approved in writing by the Contracting Officer.

1.3.1.4 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. If radio communication is approved by Contracting Officer / installation security office, frequency selection shall be approved by Contracting Officer to prevent interference with installation operations. Such devices shall be provided by the Contractor and made available for use by Government personnel as requested.

1.3.1.5 APPEARANCE OF MOBILIZATION SITE FACILITIES AND/OR TRAILERS

Mobilization Site Facilities and/or Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers or other transportable structures which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the construction site until such work or maintenance has been performed to the satisfaction of the Contracting Officer.

1.3.1.6 MAINTENANCE OF STORAGE AREA

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse unpaved areas which are not established roadways with construction equipment or other vehicles, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of soil onto paved or established roadways; gravel gradation shall be at the Contractor's discretion.

1.3.1.7 SECURITY PROVISIONS

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own facilities and equipment in accordance with Contract Section 01040.

1.3.1.8 SANITATION

a. The Contractor shall comply with the sanitation requirements of Section 02 of 385-1-1.
b. Sanitary Facilities: The Contractor shall be responsible for maintaining such facilities at no expense to the Government.
c. Trash Disposal: The Contractor shall be responsible for collection and disposal of trash from the work areas and from the mobilization area. General construction debris and demolition debris shall be collected and transported by the Contractor to a location designated by the Government. Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Loose debris capable of being windblown, shall be immediately placed in sealed or covered containers to prevent it from being blown onto taxiways or runways. Any dirt or soil that is tracked onto paved or surfaced roadways shall be cleaned daily. Materials resulting from demolition activities that are salvageable shall be stored within the fenced area described above. Stored material not indoors, whether new or salvaged, shall be neatly stacked when stored.

1.3.1.9 TELEPHONE

The Contractor shall make arrangements to install and pay all costs for telephone facilities desired.

1.3.1.10 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of mobilization facilities, trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse unpaved areas shall be removed and all such areas restored to their original conditions.

1.3.2 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the Host Nation and base authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with base traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.3.2.1 USE OF EXISTING ROADS AS HAUL ROUTES

The Contractor shall be responsible for coordinating with the base authorities for use of any existing roads as haul routes. Construction, and routing of new haul roads, and/or upgrading of existing roads to carry anticipated construction traffic shall be coordinated with the Base authorities and is the sole responsibility of the Contractor.

1.3.2.2 EMPLOYEE PARKING

The Contractor’s employees may be allowed parking on the military installation. The Contractor is responsible for transporting workers (local nationals) from off post to the worksite, coordinating security identification screening, and cooperating in gate searches with the base authorities. The government reserves the right to terminate any and all contractor parking at any time.

1.3.3 TEMPORARY PROJECT SAFETY FENCING AND BARRICADES

The Contractor shall impose all measures necessary to limit public access to hazardous areas and to ensure the restriction of workers to the immediate area of the construction and mobilization site. The Contracting Officer may require in writing that the Contractor remove from the work any employee found to be in violation of this requirement.

1.3.3.1 BARRICADES

Barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Travel to and from the project site shall be restricted to a route approved by the Contracting Officer.

1.3.4 HOST NATION AUTHORIZATIONS, PERMITS AND LICENSES

It shall be the Contractor's responsibility to obtain such local authorizations, permits and licenses necessary to establish his quarry operations, batching operations and haul routes (See Special Clause entitled: COMPLIANCE WITH HOST COUNTRY RULES AND CUSTOMS).

1.4 RESPONSIBILITY FOR PHYSICAL SECURITY

Prior to mobilization, the Contractor shall submit his proposed means of providing project security to meet the requirements of Contract Section 01040 and prevent unauthorized access to equipment, facilities, materials and documents, and to safeguard them against sabotage, damage, and theft. The Contractor shall be responsible for physical security of all materials, supplies, and equipment of every description, including property which may be Government-furnished or owned, for all areas occupied jointly by the Contractor and the Government, as well as for all work performed.

1.5 DUST CONTROL

The Contractor shall be required to control objectionable dust in the work areas, access roadways, and haul roads by means of controlled vehicle speeds or dust palliatives. Vehicles transporting sand, cement, gravel or other materials creating a dust problem shall be covered, as directed by the Contracting Officer, or in accordance with local Laws, codes, and regulations.

1.6 DIGGING PERMITS

1.6.1 REQUIREMENTS FOR DIGGING PERMITS

Prior to the start of any work activity that requires excavation within the current base, the Contractor shall obtain a digging permit.

1.6.2 REQUESTS FOR DIGGING PERMITS

Requests for Digging Permits shall be submitted to Contracting Officer a minimum of seven (7) days prior to the start of the work activity covered by the permit. The request for a Digging Permit shall include a narrative description of the work to be performed and a detailed map of the area of the excavation clearly marking the location of all known utilities or other obstructions. If the work activity covered by the Digging Permit request also requires a utility outage, a separate request for the outage shall be submitted in accordance with the paragraph entitled CONNECTIONS TO EXISTING UTILITIES.

1.6.3 PREPARATION OF REQUESTS FOR DIGGING PERMITS

Prior to submitting a request for a Digging Permit, the Contractor shall carefully review the area to be excavated to determine the location of existing utilities and other obstructions. The Contractor shall review available drawings and will conduct a visual inspection of the site. The Contractor shall utilize underground utility detecting devices such as metal and cable detectors to determine the location of existing utilities. All utility lines found shall be clearly flagged or marked and the location of the utility shall be shown on the drawing to be submitted with the request for Digging Permit.

1.6.4 EXISTING UNDERGROUND UTILITIES

The Contractor shall exercise utmost care in researching locations of existing utilities and reducing damage to existing utilities. Any utilities damaged by the Contractor shall be promptly repaired by the Contractor. The Contracting Officer will review and approve any proposed repairs. Any damage to existing utilities will be immediately reported to the Contracting Officer and the Base Commander.

1.7 CONNECTIONS TO EXISTING UTILITIES

1.7.1 GENERAL

Any outage involving disruption of electrical service beyond the site area shall be requested in writing at least ten (10) days in advance of the date requested for the commencement of the outage. The Contractor shall provide a request, detailing the type of outage needed (water, sewer, electrical, steam, etc.), the time needed to perform the work, the reason for the outage, and the known affected facilities. The Contracting Officer shall be contacted prior to the outage to confirm the time and date. If the Contractor fails to initiate work at the approved time, the Contracting Officer may cancel the approved outage and may direct the Contractor to resubmit a new request. No part of the time lost due to the Contractors failure to properly schedule an outage shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

1.7.1.1 PERFORMANCE OF WORK DURING NON-STANDARD HOURS

To minimize outage impact to the mission of the installation, all outages shall be scheduled on weekends or after the project area's regular base duty hours and/or as directed by Contracting Officer Representative (COR). The period proposed for performance of the outage shall include sufficient contingencies to preclude impact to the peak working hours during the workweek.

1.7.1.2 EXTERIOR NIGHT LIGHTING

Exterior night lighting shall be provided in conformance with EM-385-1-1 entitled Safety and Health Requirements Manual.

1.7.2 EXISTING UNDERGROUND UTILITIES

The Contractor is provided notice that existing utilities may be present in the construction area. The Contractor shall exercise the utmost care in researching locations of existing utility lines by implementing control measures to eliminate, or reduce to a level acceptable to the Contracting Officer, the chance of damaging or destroying existing utilities.

1.7.2.1 USE OF UNDERGROUND UTILITY DETECTING DEVICE

Prior to any excavation, a metal and/or cable-detecting device shall be used along the route of the excavation. All underground utilities discovered by this method will be flagged a minimum distance of one-half (1/2) meter on each side of the location.

1.7.2.2 HAND EXCAVATION

Hand excavation methods and special supervisory care shall be used between any flagged markers, in areas of known or suspected hazards, and in areas known or suspected to have multiple and/or concentrated utility lines or connections.

1.7.3 REPAIR OF DAMAGED UTILITIES

The Contractor shall be responsible to repair any utilities damaged by him. The method of repair and schedule for performance of the repair shall be coordinated with, and subject to the approval of, the Contracting Officer. The repair work and any temporary work required to keep the system operational while repairs are being completed, shall be performed at no cost to the Government.

1.8 WATER

The Contractor shall install and maintain necessary supply connections and piping for same, but only at such locations and in such manner as may be approved by the Contracting Officer. Water required for final testing, adjusting and balancing of HVAC systems will be the responsibility of the Contractor. Before final acceptance of systems, or facilities, all temporary connections and piping installed by the Contractor shall be removed at his expense in a manner satisfactory to the Contracting Officer.

1.9 ELECTRICITY

Electrical service is not available for use under this contract; therefore all electric current required by the Contractor shall be the responsibility of the Contractor, furnished at his own expense. The Contractor shall provide diesel generators to meet his demand requirements. Electricity required for final testing systems will be the responsibility of the Contractor. The means of doing so, such as by temporary distribution systems, shall be the responsibility of the Contractor. All temporary connections for electricity shall be subject to the approval of the Contracting Officer and shall comply with Corps of Engineers manual EM 385-1-1 entitled Safety and Health Requirements Manual. All temporary lines shall be furnished, installed, connected and maintained by the Contractor in a workmanlike manner satisfactory to the Contracting Officer. Before final acceptance of systems, or facilities, all temporary connections installed by the Contractor shall be removed at his expense in a manner satisfactory to the Contracting Officer.

1.10 WORK OUTSIDE REGULAR HOURS

If the Contractor desires to carry on work outside the project area’s regular base duty hours, or on holidays, including the following U.S. holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving and Christmas, he shall submit an application to the Contracting Officer. Due to reliance upon local national laborers and time off due to local observances, there may be disruptions. Potentials dates are the following local observances: National Islamic Holiday of Ashura, Ramadan (actual date varies – check with local authorities). The Contractor shall allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, exterior lighting shall be provided in conformance with EM-385-1-1 entitled "Safety and Health Requirements Manual".

1.11 SCHEDULING OF WORK IN EXISTING FACILITIES

As soon as practicable, but in any event not later than thirty (30) calendar days after award of this contract, the Contractor shall meet in conference with the Contracting Officer, or his duly authorized representatives, to discuss and develop mutual understanding relative to the scheduling of work in and access to the existing facilities where work has to be performed under this contract, so that the Contractor's proposed construction schedule is coordinated with the operating and security requirements

of the installation.

1.12 SPECIAL FACILITIES AND SERVICES TO BE FURNISHED BY THE CONTRACTOR

The Contractor shall furnish the facilities and services listed in this clause for Corps of Engineers personnel and other persons as designated by the Contracting Officer. All facilities, furnishings, materials, and equipment shall be new when furnished at the site. The Contractor shall fully maintain and repair all facilities, furnishings and equipment listed below. All facilities, furnishings, materials, and equipment furnished and/or installed by the Contractor under this clause shall remain the property of the Contractor at the completion of the contract. Facility structures shall be modular or containerized, suitable for easy movement at a later date.

1.13 PREPARATION OF AS-BUILT DRAWINGS (CONTRACTOR)

1.13.1 AS-BUILT DRAWING SUBMITTALS

a. Government approval is required for As-Built drawings as below in accordance with Section 01335, SUBMITTAL PROCEDURES.
b. Drawings showing final as-built conditions of the project. The final CAD as-built drawings shall be submitted in accordance with section 01780A 1.1 SUBMITTALS.

1.13.2 AS-BUILT DRAWINGS

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.13.2.1 GOVERNMENT FURNISHED MATERIALS

One set of electronic CAD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CAD file as-built drawings.

1.13.2.2 FINAL AS-BUILT DRAWINGS

The Contractor shall update the digital contract drawing files to reflect the approved final as-built conditions and shall furnish those updated drawing files and plots of the final as-built drawings to the Contracting Officer. As-built drawings shall be in the English language.

a. Only personnel proficient in the use of Computer Assisted Design and Drafting (CAD) for the preparation of drawings shall be employed to modify the contract drawing files or prepare new drawing files.
b. Existing digital drawing files shall be updated to reflect as-built conditions. Independent drawing files containing only as-built information are not acceptable. The modifications shall be made by additions and deletions to the original drawing files, and where additional drawings are necessary, they shall be developed in individual digital files for each new drawing. All additions and corrections to the contract drawing files shall be clear and legible, and shall match the adjacent existing line work and text in type, size, weight, and style. New or revised information placed into the design files shall be placed on the levels and in the colors used for placement of the corresponding initial data. Similarly, the drawing size, title block, and general format of new drawings shall be consistent with the format established by the original drawings.
c. In the preparation of as-built drawings, the Contractor shall remove "Bubbles" used by the Government to highlight drawing changes made during design/construction. Deltas (triangles) associated with those earlier drawing changes shall be left on the drawings and the Contractor shall not add deltas (triangles) to designate modifications associated with representation of the as-built

condition. The revision history block identification of the drawing modifications shall be left intact and the date of completion and the words "REVISED AS-BUILT" shall be placed in the revision history block above the latest existing notation. Each drawing shall have the words "DRAWING OF WORK AS-BUILT" in letters 4.5 mm (3/16") high placed below the drawing title portion of the drawing title block, between the border and the trim line.

d. The Contractor shall check all final as-built drawing files for accuracy, conformance to the initial drawing scheme and the above instructions. The Contracting Officer will review the drawings and drawing files for conformance to these standards.

e. The Contractor shall furnish the digital as-built drawing files in the format native to either AutoDesk AutoCAD 2009 or newer or Bentley Microstation Version 8 (which is easily convertible in both directions to/from AutoCAD). The Government will only accept the final product for full operation, without conversion or reformatting, in these formats.

f. Digital drawing files shall be furnished to the Contracting Officer on CD-ROM or other media and format as approved by the Contracting Officer. A transmittal sheet containing the name of the files, the date of creation, the CD-ROM number, and a short description of the contents, shall accompany the CD-ROM.

g. A sample drawing shall be furnished to the Contracting Officer before delivery of final as-built drawings as a test to demonstrate compliance with the above instructions, file format compatibility with the described CAD software, and all CAD standards as stipulated in Section 01335.

h. One (1) complete set of the updated final Record Copy digital drawing files and one (1) paper plot or copy of the final Record drawings shall be delivered to the Contracting Officer upon completion of each road. If upon review of the final as-built drawings, errors or omissions are found, the drawings and drawing files will be returned to the Contractor for corrections. The Contractor shall complete the corrections and return both the digital files and the as-built prints to the Contracting Officer within ten (10) calendar days.

In addition, if the Contractor fails to provide the final as-built drawings within thirty (30) calendar days after contract completion, the Contracting Officer will deduct from the final contract payment an amount representing the lesser of 1% of the total contract cost or $50,000.

1.13.3 DRAWING PREPARATION

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.13.4 COMPUTER AIDED DESIGN AND DRAFTING (CAD) DRAWINGS

a. Only personnel proficient in the preparation of CAD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CAD files. The Contractor shall be furnished "as-designed" drawings in AutoCAD Release 2009 or Microstation V8 format compatible with a Windows XP operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor

shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings.

b. Prior to submittal of the first design submittal involving CAD drawings, the Contractor shall prepare one typical CAD drawing for the project and furnish, via ENG Form 4025, the electronic CAD drawing file for review and approval by the Contracting Officer. All Government comments involving changes to this single drawing shall be accomplished and re-submittal(s) made until the Government is satisfied that all CAD Standards are being followed and all subsequent drawings will also be in compliance with these Standards.

c. CAD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

   1. Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.
   2. Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.
   3. Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

d. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line weights the same as the drawing. Special notes shall be in blue on layer#63.

e. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 5 mm 3/16 inch high. All other contract drawings shall be marked either "As-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

f. After Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CAD as-built drawings for that phase of work and submit two sets of full size paper copy prints of these drawings for Government review, comparison with approved red-line marked up drawings, and approval. The Government will promptly return one set of prints annotated with any necessary corrections to the CAD file(s) if corrections are required prior to approval. Within 20 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), one set of full size paper prints and one set of the approved working as-built drawings. Data on the CD-ROM shall be organized per the instructions in Section 1335 and per the diagram in Section 1335a. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this are the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the CAD system. Upon approval by the Government of the final as-built drawing package for the entire project, the Contractor shall provide the number of as-built copies noted in Paragraph 1.1 of this Section.

g. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.13.5 PAYMENT

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.14 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in accordance with Section 01335 SUBMITTAL PROCEDURES FOR

DESIGN/BUILD. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company involved and shall contain the name and address of the Contractor, the project name and location, description and the quantity of the items involved, and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material.

1.15 ACCIDENT PREVENTION

The Contractor shall comply with all applicable Host Country laws and with such additional measures as the Contracting Officer may find necessary in accordance with CONTRACT CLAUSE 52.236-13 entitled ACCIDENT PREVENTION (NOV1991)-ALTERNATE 1 (APR 1984). Applicable provisions of the Corps of Engineers manual entitled Safety and Health Requirements Manual EM 385-1-1 will be applied to all work under this contract. The referenced manual may be obtained from the Contracting Officer at the jobsite or from the Afghanistan Engineer District at Kabul, Afghanistan.

1.15.1 ACCIDENT PREVENTION PROGRAM

Within seven (7) days after NTP and at least ten (10) days prior to the accident prevention pre-work conference, four (4) copies of the Accident Prevention Plan required by the CONTRACT CLAUSE 52.236-13 entitled ACCIDENT PREVENTION (NOV 1991)- ALTERNATE I shall be submitted for review by the Contracting Officer. The Contractor shall not commence physical work at the site until the Accident Prevention Plan (APP) has been reviewed and accepted by the Contracting Officer. The APP shall meet the requirements listed in Appendix "A" of EM385-1-1. The program shall include the following: TAC Form 61 " Accident Prevention Program Hazard Analysis (Activity Hazard Analysis)" fully completed and signed by an executive officer of the company in block No. 13. The Activity Hazard Analysis is a method in which those hazards likely to cause a serious injury or fatality are analyzed for each phase of operations. Corrective action is planned in advance, which will eliminate the hazards. An analysis is required for each new phase of work. On large or complex jobs the first phase may be presented in detail with the submittal of the Accident Prevention Plan rather than presenting the complete analysis. If the plan is to be presented in phases, a proposed outline for future phases must be submitted as a part of the initial Accident Prevention Plan submittal. Accident Prevention Plans will be reviewed for timeliness and adequacy at least monthly with a signature sheet signed and dated documenting that these reviews took place. The Contractor shall provide a copy of his company policy statement of Accident Prevention and any other guidance as required by EM 385-1-1, Appendix A.

1.15.2 GROUND FAULT CIRCUIT INTERRUPTER (GFCI) REQUIREMENT – OVERSEAS CONSTRUCTION

The Corps of Engineers Health and Safety Manual, EM 385-1-1, section 11.C.05.a. states: "The GFCI device shall be calibrated to trip within the threshold values of 5 ma +/- 1 ma as specified in Underwriters Laboratory (UL) Standard 943." A variance from USACE has been granted allowing 10 ma, in lieu of 5 ma, for overseas activities that use 220 Volts (V)/50 hertz (Hz) electrical power.

1.15.3 TEMPORARY POWER - ELECTRICAL DISTRIBUTION BOXES

EM 385-1-1 section 11.A.01.a. states, "All electrical wiring and equipment shall be a type listed by a nationally recognized testing laboratory for the specific application for which it is to be used." This includes temporary electrical distribution boxes. Locally manufactured electrical boxes will not be allowed. Only manufactured electrical distribution boxes that meet the European CE requirements, with 10 ma CE type GFCIs installed shall be allowed.

Contractors shall:

a. Make no modifications that might void any CE or manufacturer certification.

b. Test the installed systems to demonstrate that they operate properly and provide the 10 ma earth leakage protection.
c. Ensure GFCIs will have an integral push-to-test function. The testing shall be performed on a regular basis.
d. Check that proper grounding is checked regularly and flexible cords, connectors, and sockets inspected before each use.
e. Comply with all requirements of Section 11 of 385-1-1 Safety Manual.
f. Submit a sketch of the proposed temporary power distribution system to the GDA as a part of the Accident Prevention Plan.

1.16 HAZARDOUS MATERIALS

Should the Contractor encounter asbestos or other hazardous materials, during the construction period of this contract, he shall immediately stop all work activities in the area where the hazardous material is discovered. The Contractor shall then notify the Contracting Officer; identify the area of danger; and not proceed with work in that area until given approval from the Contracting Officer to continue work activities. Hazardous material is considered to be asbestos, explosive devices, toxic waste, or material hazardous to health and safety. The Contractor shall secure the area from daily traffic until it is safe to resume normal activities.

1.17 OPERATION AND MAINTENANCE (O&M)

1.17.1 GENERAL

The requirements contained herein are in addition to all shop drawings submission requirements stated in other sections of the specifications. The Contractor shall include the provisions for all items required under this clause in all purchase orders and sub-contract agreements. Submittals required hereinafter will not relieve the Contractor of any responsibilities under the Warranty of Construction Provisions of this contract or under the various Guarantee Clauses of the Technical Provisions.

1.17.2 SUBMITTALS

The Contractor shall submit all items requiring submission of O&M data under this and other sections of these specifications in accordance with Section 01335 SUBMITTAL PROCEDURES FOR DESIGN/BUILD of the specifications.

1.17.3 OPERATION AND MAINTENANCE (O&M) DATA

The Contractor shall furnish operation and maintenance manuals for all facilities constructed under this contract. The manuals shall be loose leaf, indexed and shall consist of manufacturer's brochures, manufacturer's operation and maintenance manuals, service and repair manuals, catalogs, service bulletins, instruction charts, diagrams, other information as necessary to support the operation and maintenance of the end items of equipment, assemblies and systems. Each type of facility (housing, barracks, mosque, etc.) shall be covered by a separate manual (or manuals) consisting of all data pertaining to the equipment and/or systems within that facility. Identical equipment within a single major system shall require only one submittal of data. The Contractor shall furnish all O&M manuals to the Contracting Officer not less than thirty (30) calendar days prior to contract completion. If the Contractor fails to furnish all O&M manuals to the Contracting Officer as specified herein, the Contracting Officer will deduct from the final contract payment an amount representing the lesser of 1% of the total contract cost or $50,000. Required number of submittals (number of sets) shall be as specified in Section 01335 SUBMITTAL PROCEDURES FOR DESIGN/BUILD.

1.17.4 SUPPLEMENTAL SUBMITTALS OF DATA

After initial submittal of O&M manuals and until final acceptance of all equipment, the Contractor shall

prepare and deliver to the Contracting Officer supplemental technical data as previously described for all changes, modifications, revisions and substitutions to equipment and components. For equipment or systems introduced into the contract under change order, or modified by change order, supplemental data shall be furnished within forty-five (45) calendar days after issuance of the change order. The supplemental data furnished shall be properly prepared and identified for insertion into the O&M manuals.

1.17.5 FRAMED INSTRUCTIONS FOR SYSTEMS

Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves and control sequence, framed under glass or in approved laminated plastic, shall be posted, where applicable, in all mechanical equipment rooms. In addition, detailed operating instructions explaining safe starting and stopping procedures for all systems shall be prepared in typed form along with the inspections required to insure normal safe operations. The instructions shall be framed as specified above for the wiring and control diagrams and posted beside the diagram. Proposed diagrams, instructions, and other sheets shall be submitted for approval prior to posting. Operating instructions shall be posted before acceptance testing of the systems and verified during acceptance testing.

1.17.6 ADDITIONAL SUBMITTALS/RE-SUBMITTALS

The Contracting Officer reserves the right to determine whether the above specified information, as furnished by the Contractor, is adequate and complete and to require such additional submittals by the Contractor as necessary to insure that adequate information has been furnished to provide the satisfactory operation and maintenance of the various items of equipment and to fulfill the intent of the specifications. Additional submittals or re-submittals supplementing incorrect or incomplete data shall be made within thirty (30) calendar days after receiving notice by the Contracting Officer. All costs arising from these resubmissions shall be borne by the Contractor.

1.18 INSTRUCTIONS AND TRAINING FOR OPERATION AND MAINTENANCE

1.18.1 GENERAL

The Contractor shall be responsible for the instruction and training of operating and maintenance personnel as specified below and in the Technical Provisions of the specifications. Unless otherwise indicated in the Technical Provisions, operating and maintenance instructions shall be given for a minimum period as follows:

Title	Duration of Training
Mechanical Systems	10 Days
Electrical Systems	10 Days

1.18.2 OPERATION AND MAINTENANCE TRAINING

The Contractor shall provide competent instructors for training of personnel designated by the Contracting Officer to operate mechanical and electrical building systems and equipment, perform the required preventive maintenance to minimize breakdown, and to perform necessary repairs when malfunction or breakdown of equipment occurs. Such training shall consist of classroom and on-the-equipment training for the period specified, which shall be completed prior to acceptance of a system or equipment, as applicable. The instructor(s) shall have no other duties during the period of training. Classroom instruction shall not exceed fifty percent (50%) of the total training time, with the balance devoted to on-the-equipment demonstration and familiarization. Emphasis will be given to both electrical and mechanical features, in accordance with approved training plans.

1.18.3 ARRANGEMENTS

The training shall be for not less than the periods of time specified, five (5) days per week, and eight (8) hours per day, subject to review and approval by the Contracting Officer. Each individual training session shall be presented one time only, shall be video taped in a television system compatible with the local area, and be scheduled in a manner acceptable to the Contracting Officer. At the completion of training, the videotapes shall become the property of the Government. In addition to the Contractor's requirements to video tape each training section, the Government reserves the right to record, in any manner, the subject training material, or training sessions given by the Contractor, without additional cost to the Government.

Recordings obtained will be used in future training by the Government. The operating and maintenance manual data, as specified to be furnished in these Special Clauses, shall be used as the base material for training.

1.18.4 SCHEDULING

The Contractor shall contact the Contracting Officer for the purpose of preliminary planning, scheduling, and coordination of training, to maximize effectiveness of the training program for available operating and maintenance personnel. The Contractor shall initiate and make arrangements for such contact within thirty (30) calendar days after receipt of notification of award of contract; and shall include all significant times in scheduling and completing training in his PROJECT SCHEDULE. The Contractor shall provide a draft outline of training outline in sufficient detail to provide a broad indication of the type of scope of training to be given. It shall include but not be limited to; (a) a list of subjects to be presented; (b) estimated amounts of classroom and on-the-equipment instruction for each subject; (c) a list of minimum qualifications for instructors; and (d) discussions concerning the types and amounts of visual aids, reference materials, tools and test equipment, mock-up and other training materials that will be employed during training.

1.18.5 PRELIMINARY PLAN

The Contractor shall submit seven (7) copies of an outline of his proposed training plan to the Contracting Officer for review and approval not later than 60 calendar days after award of this contract. The plan will be reviewed and coordinated with the content of the O&M manuals.

1.18.6 PLAN

The Contractor shall submit seven (7) copies of his proposed training plan to the Contracting Officer for approval not later than ninety (90) calendar days prior to start of any training. The plan shall include the following; (a) a weekly outline showing overall form and design of training presentation; (b) a day-by-day schedule showing time intervals, the major and subordinate subjects to be covered in each, the name of the instructor(s) and qualification summary of each, and identification of related handouts; (c) summary of the number of hours of classroom and on-the-equipment training; (d) a list of reference materials to be provided by the Contractor to the trainees; and (e) a list and description of the training materials to be used, such as text, visual aids, mock-up, tools, etc. The Contractor shall be responsible for furnishing all training materials except the following: The Government will provide space, chairs, and tables for classroom training, and three (3) sets of the five (5) sets of O&M Manuals required by the Contractor per Section 01335 SUBMITTAL PROCEDURES FOR DESIGN/BUILD of the specifications. Provision of these manuals is solely for reference purposes, and in no way relieves the Contractor from providing all instruction and materials necessary for training personnel designated by the Government. All costs for resubmission of training plans, training materials, etc., as requested by the Contracting Officer shall be borne by the Contractor. Re-submittals shall be made within twenty (20) days of notice from the Contracting Officer.

1.18.7 ATTENDANCE ROSTER/TAC FORM 356

The Contractor shall develop an attendance roster or a similar document indicating each student's attendance, prior to the start of each class, subject and/or topic. This includes both "Hands-On" and classroom training. It is strongly recommended that each student trained be required to sign this document at the beginning of each class day for each and every class, subject and/or topic taught on that day. The Contractor's failure to have student attendance verified in writing may be cause for the Government to order the Contractor to repeat schooling where evidence of attendance cannot be verified. No part of the time lost due to such repeat instruction shall be made the subject of claim for extension of time or for excess costs or damage by the Contractor. Within ten (10) working days after completion of Operation and Maintenance Training conducted in accordance with this clause and/or applicable Technical Provision section, the Contractor shall complete and submit TAC Form 356 "Operation and Maintenance Training Validation Certificate". The attendance roster shall be included as an attachment to TAC Form 356.

1.19 CONTRACTOR FURNISHED EQUIPMENT LISTS

The Contractor shall furnish a list of all items, other than integral construction type items, furnished under the contract. Items such as furniture, drapes, rugs, vehicles, office machines, appliances, etc., shall fall under this category. The Contractor's list shall describe the item; give the unit price and total quantities of each. Model and serial numbers for equipment shall be provided when applicable. The Contractor shall keep an up-to-date register of all covered items and make this information available to the Contracting Officer at all times. Prior to acceptance, the Contractor shall submit the complete register to the Contracting Officer.

1.20 TIME EXTENSIONS

1.20.1 GENERAL

This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the Contract Clause 52.249-10 entitled DEFAULT (FIXED-PRICE CONSTRUCTION) APR 1984. The listing below defines the anticipated monthly unusually severe weather for the contract period and is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the geographic location of the project. The schedule of anticipated unusually severe weather will constitute the baseline for determining monthly weather time evaluations. Upon award of this contract and continuing throughout the contract each month, actual unusually severe weather days will be recorded on a calendar day basis (including weekends and holidays) and compared to the monthly anticipated unusually severe weather in the schedule below. The term "actual unusually severe weather days" shall include days actually impacted by unusually severe weather. The Contractor's schedule must reflect the anticipated unusually severe weather days on all weather dependent activities.

Logar Province - Pul-i-Alam

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
21	19	10	02	01	00	00	00	01	08	16	20	98

1.20.2 TIME EXTENSIONS

The number of actual unusually severe weather days shall be calculated chronologically from the first to the last day in each month. Unusually severe weather days must prevent work for fifty percent (50%) or more of the Contractor's workday and delay work critical to the timely completion of the project. If the number of actual unusually severe weather days exceeds the number of days anticipated in the paragraph above, the Contracting Officer will determine whether the Contractor is entitled to a time

extension. The Contracting Officer will convert any qualifying delays to calendar days and issue a modification in accordance with the Contract Clause 52.249-10 entitled DEFAULT (FIXED-PRICE CONSTRUCTION) APR 1984.

1.20.3 OTHER DELAYS

Construction delays due to full or partial base closures due to incidents such as demonstrations, civil unrest and outright attacks will be examined on an individual basis for consideration of time extensions.

1.21 STANDARDIZATION

Where two or more items of the same type or class of product, system or equipment furnished in this project are required, the units shall be products of the same manufacturer and shall be interchangeable when of the same size, capacity, performance characteristics, and rating. The only exception to this requirement is where the items are interchangeable due to conformance with industry standards (valves, fittings, etc.); they need not be by the same manufacturer. This requirement applies to all manufactured items in the project that normally require repair or replacement during the life of the equipment.

1.22 COMPLIANCE WITH HOST COUNTRY RULES AND CUSTOMS

The laws of Host Country may prohibit access to certain areas of the country that are under military control. The Contractor shall furnish the Contracting Officer the names of personnel, type, and amounts of equipment, dates and length of time required at the site, and the purpose of entering the host country. It is understood that areas to which rights of entry are provided by the Host Government are to be used only for work carried out under the contract and no destruction or damages shall be caused, except through normal usage, without concurrence of the Host Government.

1.22.1 CONTRACTOR'S RESPONSIBILITIES

The following items are the sole responsibility of the Contractor to investigate, estimate as to cost, and assume the risk, as normally encountered by Contractors. The Contractor shall be responsible for determining the effect of the following on his own cost of performance of the contract and for including sufficient amount in the contract price:

a. Official language and type of accounts required to satisfy the officials of the Local Government.
b. Entry and exit visas, residence permits, and residence laws applicable to aliens. This includes any special requirements of the Host Government, including those required by local Labor Offices, which the Contractor may have to fulfill before an application for a regular block of visas will be accepted.
c. Passports, health and immunization certificates, and quarantine clearance.
d. Compliance with local labor and insurance laws, including payment of employer's share of contribution, collecting balance from employee and paying into insurance funds.
e. Strikes, demonstrations and work stoppage.
f. Collection through withholding and payment to local Government, of any Host Country income tax on employees subject to tax.
g. Arranging to perform work in the Host Country, to import personnel, to employ non-indigenous labor, to receive payments and to remove such funds from the country.
h. Operating under local laws, practices, customs and controls, and with local unions, in connection with hiring and firing, mandatory wage scales, vacation pay, severance pay, overtime, holiday pay, 7th day of rest, legal notice or pay in lieu thereof for dismissal of employees, slowdown and curtailed schedules during religious holidays and ratio of local labor employed in comparison to others.
i. Possibility of claims in local bureaus, litigation in local courts, or attachment of local bank accounts.
j. Compliance with workmen's compensation laws and contributions into funds. Provisions of necessary medical service for Contractor employees.
k. Special license required by the local Government for setting up and operating any manufacturing plant in the Host Country, e.g. concrete batching, precast concrete, concrete blocks, etc.
l. Sales within the host country of Contractor-owned materials, and equipment.

m. Special licenses for physicians, mechanics, tradesmen, drivers, etc.
n. Identification and/or registration with local police of imported personnel.
o. Stamp tax on documents, payments and payrolls.
p. Base passes for permanent staff, day laborers, motor vehicles, etc.
q. Compliance with all customs and import rules, regulations and restrictions, including, but not limited to, local purchase requirements.

1.23 EMPLOYEE ACCESS TO PROJECT SITE

1.23.1 EMPLOYEE IDENTIFICATION

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work, to display identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.23.1.1 PREPARATION OF IDENTIFICATION BADGES

The Contractor shall be required to prepare a written application inclusive color photographs and provide all materials and labor necessary to prepare an identification badge, laminated in plastic, containing the employee's name, badge number, color photo, height and weight, the name of the Contractor's organization and for requiring each employee engaged on the work to display this identification as directed by the Contracting Officer. The Contractor shall submit each application and draft badge through the Contracting Officer to the Base Security Office. A minimum of thirty-five workdays shall be allowed for Government review and certification of badges. The Base Security Office will certify each draft badge by signature, stamp, seal or any combination thereof. Upon certification by the Base Security Office, the badges will be returned to the Contractor for final preparation, lamination, and issuance. Badges shall not be taken out of country during periods of travel or absence. During such periods, the Contractor may be permitted to issue temporary identification badges.

1.23.1.2 EMPLOYEE BACKGROUND AND HISTORICAL INFORMATION

The Contractor shall be required to prepare and maintain personal background and historical information forms on each employee. These forms may be reviewed by the Base Security Office. The required information shall include but not necessarily be limited to the following:

a. Full name.
b. Place and date of birth.
c. Three (3) current color photographs.
d. Copy of Citizenship/Nationality identification.
e. Copy of Passport.
f. Copy of driver’s license.
g. Police Background Check.
h. Work History.
i. Personal background information.
j. Copy of Work Permit and/or Visa.
k. Permanent home of record and in-country address.
l. Other information mandated by local law, the Base Security Regulations or that may be required to coordinate and process the necessary documentation with the government offices responsible for the approval.
m. Registration, insurance company, policy number and expiration date for each vehicle.

1.23.2 IDENTIFICATION OF CONTRACTOR VEHICLES

The Contractor shall be responsible for requiring each vehicle engaged in the work to display permanent vehicular identification as approved and directed by the Contracting Officer. If acceptable to the Base Security Office and approved by the Contracting Officer, the Contractor may institute a system of non-permanent temporary identification for one-time delivery and transit vehicles. Each Contractor vehicle, machine, piece of equipment, or towed trailers, shall show the Contractor's name such that it is clearly visible on both front doors of the vehicle and both sides of a towed trailer. A valid license plate shall be displayed at all times. Contractor vehicles operated on Government property shall be maintained in a good state of repair, shall be insured, and shall be registered in accordance with Afghan Law.

1.23.3 SECURITY PLAN

The Contractor shall submit to the Contracting Officer a security plan as required in Contract Section 01040.

1.24 RADIO TRANSMITTER RESTRICTIONS

To preclude accidental actuation of sensitive electronic equipment, the Contractor shall not use radio-transmitting equipment without prior approval of the Contracting Officer.

1.25 PUBLIC RELEASE OF INFORMATION

1.25.1 PROHIBITION

There shall be no public release of information or photographs concerning any aspect of the materials or services relating to this bid, contract, purchase order, or other documents resulting there from without the prior written approval of the Contracting Officer.

1.25.2 SUBCONTRACT AND PURCHASE ORDERS

The Contractor agrees to insert the substance of this clause in all purchase orders and subcontract agreements issued under this contract.

1.26 CONSTRUCTION PROJECT SIGN

The contactor shall fabricate and display at least one sign to identify the project site as a Government of the Islamic Republic of Afghanistan sponsored project associated with the Ministry of the Interior. The sign shall measure at least 1.8 x 1.2 meters as shown in Attachment. The sign shall be fixed to posts with a sufficient number of bolts to ensure that the sign will not be damaged by weather or vandalism. A minimum of three posts will be utilized. If lumber is used for support posts, the minimum dimension of the lumber vertical posts and bracing will be 10 cm x 10cm. The post will set in field-prepared site-grade concrete. No rebar (reinforcement) and no form work are required for concrete. At any point during construction if deemed necessary by the COR the sign shall be repaired or replaced. Exact placement at the project site shall be coordinated with the COR.

The black, green and red colors on the left side of the sign shall be the Pantone colors listed below:

Black: Pantone Process Black PC
Red: Pantone 485 PC
Green: Pantone 370 PC

Sign panels shall be fabricated from 19mm thick High Density Overlay (HDO) plywood or 2-mm thick sheet metal primed and painted (exterior paint) with lumber or metal uprights and bracing (see the “pdf” Attachment). The sign will be primed and two-coat painted. The sign shall be placed in a location that is visible to pedestrians and/or vehicles passing the project site. Sign face and graphics shall be non-reflective vinyl film prepared on a white adhesive backing or enamel-based exterior type paint. All logos

shall be aligned left with typography center text. Dari translations shall be substituted with Pashtun in areas where the language is more predominant and appropriate. If the Text Group T6 (which is the Project Title taken from the Contract) does not make it clear to the public viewing the sign what the project purpose is, succinct wording shall be added to Text Group T2 to make this clear (for example, “Hospital Wastewater Treatment Facility Expansion” or “20 KM paved road” or other project summary), to be submitted and approved by the COR.

1.27 ATTACHMENTS

TAC FORM 61 - Accident Prevention Program Hazard Analysis

TAC FORM 356 - Operation and Maintenance Training Validation Certificate

Construction Project Sign Dimensions

Mounting Diagram

Ministry Logo

2. SPECIAL CONTRACT REQUIREMENTS

2.1 APPLICATION OF US CRIMINAL JURISDICTION

Reference DODI 5525.11. The Contractor is directed to provide all of its personnel working under this contract, and to require all of its subcontractors to provide their personnel, with written notification that - with the exception of nationals of Afghanistan and those ordinarily resident in Afghanistan - contractor and subcontractor personnel, and the dependents of contractor and subcontractor personnel who are residing with such personnel, may be subject to US criminal jurisdiction as provided for in the Military Extraterritorial Jurisdiction Act, 18 USC 3261-3267; see Section 3267(1)(A)(iii)(I) and (2)(A)(iii). A copy of the notice ***shall be furnished to the contracting officer upon award of the contract***, along with a certification by an authorized company representative attesting to the provision of the notification to contractor personnel.

2.2 ATTACKS FROM HOSTILE ENTITIES

This contract is firm fixed-price. Costs incurred in the performance of project execution that arise from the attacks of hostile entities, such as costs arising from damage to or destruction of contractor equipment and facilities, and damage to or destruction of the project prior to Government acceptance, are the sole responsibility of the Contractor. The Government makes no guarantee to provide the Contractor with security, and bears no obligation to reimburse the Contractor for costs arising from the attacks of hostile entities. When appropriate, the Contracting Officer may provide the Contractor with an equitable adjustment with respect to time – but not cost – in accordance with clause 52.249-10; see 52.249-10(b)(1)(i) and (2).

2.3 INSTALLATION ACCESS AND BADGING

This contract is firm fixed-price. It is the responsibility of the Contractor to be knowledgeable of and to abide by any and all applicable installation access procedures and requirements, to include any and all badging procedures and requirements that may be necessary for contractor access to the project site. Such procedures and requirements may change over the course of contract performance; it is the responsibility of the Contractor to plan accordingly in order to meet its existing obligations under this contract. The US Army Corps of Engineers, Afghanistan Engineer District, neither controls nor is responsible for any such installation access procedures, requirements or changes thereto.

2.4 CUSTOMS CLEARANCE

Reference clauses 52.229-6 and 52.225-13. This contract is firm fixed-price. It is the responsibility of the Contractor to be knowledgeable of and to abide by any and all applicable customs clearance procedures and requirements that may be necessary for the transportation of supplies and equipment into Afghanistan. Such procedures and requirements may change over the course of contract performance; it is the responsibility of the Contractor to plan accordingly in order to meet its existing obligations under this contract. The US Army Corps of Engineers, Afghanistan Engineer District, neither controls nor is responsible for any such customs clearance procedures, requirements or changes thereto.

2.4.1 CUSTOMS PROCEDURES

Background: Every contractor/carrier importing goods into Afghanistan or exporting goods out of the country must comply with national customs regulations and procedures administered by the Afghanistan Customs Department (ACD) of the Ministry of Finance, in compliance with Afghan law. Contractors performing contracts in Afghanistan for the Department of Defense (DoD), including the U.S. Army Corps of Engineers, in support of Operation Enduring Freedom (OEF), may be entitled to certain exemptions from the payment of customs tariffs and duties on goods and materiel imported into Afghanistan for use at DoD construction projects within the country, and on export of materiel from Afghanistan after completion of a project.

Obtaining import tax exemptions and clearances for the release of construction goods and materiel through ACD is often time consuming. Early planning and realistic delivery timelines are essential to prevent avoidable project delays related to customs issues. This section provides general guidance and a list of customs procedures and documents that you may be required to fulfill or provide. Please note that this guidance is provided to alert contractors from the outset that the Afghan customs process is complex and time-consuming, and to *strongly encourage* early planning. The steps listed below are provided for informational purposes only and cannot be regarded as definitive because the ACD's procedures and requirements may change at any time.

ANY DEVIATIONS FROM THE PROCESS DESCRIBED HEREIN SHALL NOT FORM THE BASIS FOR A REQUEST FOR EQUITABLE ADJUSTMENT.

General Requirements: USACE contractors must designate an authorized employee of the company as the customs point of contact (POC), responsible for handling customs clearance issues, and must advise the USACE's Customs Coordinator by e-mail of the name and contact information for the authorized customs POC. This individual must hand-deliver all required documentation between the USACE's Customs Coordinator at Qalaa House and the US Embassy, the Afghan Ministry of Foreign Affairs, and the Customs Department of the Afghan Ministry of Finance in order to obtain required stamps and signatures.

To initiate the customs clearance process, the following steps are necessary as of the time of publication of this solicitation, but cannot be regarded as definitive:

1) Prepare a Contractor's Letter of Introduction for the Afghanistan Customs Department. The Letter of Introduction should first be emailed to the USACE Customs Coordinator at Qalaa House, Kabul Afghanistan.

2) The following hard copy *original* documents should be delivered to the USACE's Customs Coordinator at Qalaa House prior to the movement of goods into or out of Afghanistan:

   a) A completed Tax Exemption Form ("Muaffi Nama"), purchased from the Afghan Customs Department and written in the Dari language.

b) A Bill of Lading (for cargo transiting via ship and motor carrier), Airway Bill (for cargo arriving via air) or CMR (for cargo that has only traveled overland).

c) An Invoice in US Dollars only. If the goods were purchased elsewhere and invoiced in a different currency, the equivalent U.S. Dollar amount must be clearly shown.

d) A Customs Clearance Request. See Section 01060b.

e) A Packing List if the complete cargo manifest is not listed on the invoice.

f) A Certificate of Origin for cargo coming through Islam Qalat and Herat.

The USACE Customs Coordinator will check the documents to ensure that they are complete, accurate, and ready for signature.

Once all stamps and signatures are obtained on the documents listed under paragraph 2, the Afghanistan Customs Department will send them to the applicable customs clearing house and the shipment can be released for border crossing and final delivery.

Note: When a contractor imports vehicles or equipment for use by the US Government, the items can only remain in country until the contracted project is complete. At the termination of the contract, the vehicles or equipment must be exported following procedures similar to those outlined above, or the original exempted duties must be paid to the Ministry of Finance if the vehicles or equipment remain in Afghanistan.

It is the sole responsibility of the Contractor to know of and abide by all Afghan customs clearance procedures and requirements applicable to the importation of supplies and equipment into Afghanistan, and to make accurate and truthful representations on all customs documents. Please recognize that Afghan customs procedures and requirements may change over the period of contract performance. The US Army Corps of Engineers, Afghanistan Engineer District, therefore provides the information in this section for general guidance purposes only, and advises you that responsibility for customs compliance, and awareness of changing customs procedures, remains your responsibility.

Any contractor or shipping agency that violates Afghan customs procedures may be subject to legal action, including but not limited to revocation of contract, forfeiture of goods and enforced collection of fines and customs fees due the Afghan Government. All contractors and suppliers that import goods tax and duty free are subject to warehouse and storage facility inspections by USACE representatives to confirm that customs manifests are accurate and that abuse of the US Government's tax-exempt status has not occurred.

2.5 TRAVEL WARNINGS

The Contractor shall provide all personnel working under this contract, and shall require subcontractors to provide their personnel, with a written notification advising such personnel to be aware of US State Department Travel Warnings with respect to Afghanistan, available at http://travel.state.gov, in the event they wish to consider bringing their dependants into Afghanistan. A copy of the notice ***shall be furnished to the contracting officer upon award of the contract***, along with a certification by an authorized company representative attesting to the provision of the notification to contractor personnel. At no time, subject to the written approval of the contracting officer, may the Contractor allow such

dependants, or any other unauthorized individuals, to be present on the project site grounds, whether in transit or otherwise.

2.6 DRUG-FREE WORKFORCE

Documentation of the Contractor's drug-free workforce program as required by clause 252.223-7004(b) ***shall be furnished to the contracting officer upon award of the contract.***

2.7 COMBATING TRAFFICKING IN PERSONS, COMMERCIAL SEX ACTS, FORCED LABOR

A copy of the employee notification statement as required by clause 52.222-50 Alt 1 ***shall be furnished to the contracting officer upon award of the contract***, along with a certification by an authorized company representative attesting to the provision of the notification to contractor personnel.

2.8 PROMPT PAYMENT OF SUBCONTRACTORS

In accordance with 52.232.5 (b)(1)(v,), the Contractor shall furnish documentation with each progress payment which indicates that all sub-contractors and suppliers have been paid with funds from the most recent progress payment. In order for the progress payment request to be considered complete, the Contractor shall:

- submit a listing of all subcontractors, the total amount paid to each subcontractor under the contract and the dates and methods of such payments; and
- provide copies of payrolls for each subcontractor working under this contract.

2.9 SUBCONTRACTORS CLAUSE REQUIREMENT

In accordance with 52.232.27, the Contractor shall include in each subcontract, a payment clause that obligates each subcontractor to pay their subcontractors for satisfactory performance of work not later than 7 days from the date they receive payment for work under this contract.

2.10 DEFENSE BASE ACT

In accordance with FAR 52.228-3 "Workers Compensation Insurance" (Defense Base Act) the offeror is required to provide, prior to commencing work under this contract, such workers' compensation insurance or security as the Defense Base Act ("DBA") (42 U.S.C.1651 et seq.) requires and to continue to maintain it until performance is complete. The amount listed by the offeror on this Contract Line Item (CLIN) is the estimated DBA insurance premium (estimated payroll of the offeror and its subcontractors times the applicable rate(s)). The DBA insurance premium amount varies with payroll and the nature of services and will, therefore, be taken into account during price evaluation of offers. The actual amount paid by the government under that CLIN will be based on the amount of the Rutherford invoice, stamped "paid" and submitted by the offeror after contract award. In the event of recalculation of the premium by CNA based on actual payroll amounts, the contracting officer will adjust this CLIN by contract modification to reflect the actual premium amounts paid. Failure to fully comply with the Defense Base Act requirements may result in termination for default in accordance with FAR 52.249-10 Default (Fixed-Price Construction).

2.11 SUBMISSION OF DEFENSE BASE ACT CLAIMS

The Offeror's Safety Officer shall, in addition to any other duties required to be performed under this contract, do the following:

- Make timely Defense Base Act insurance claims on behalf of each employee who is injured or killed in the course of their employment under this contract; and
- Make monthly written reports to the Contracting Officer, Administrative Contracting Officer, and the Agency Safety and / or Occupational Health Manger, providing the name(s) of each such injured or

deceased employee, the circumstances surrounding each injury or death, the dates of each injury or death, the date the insurance claim was made on behalf of each employee(s), and the current status of each claim.

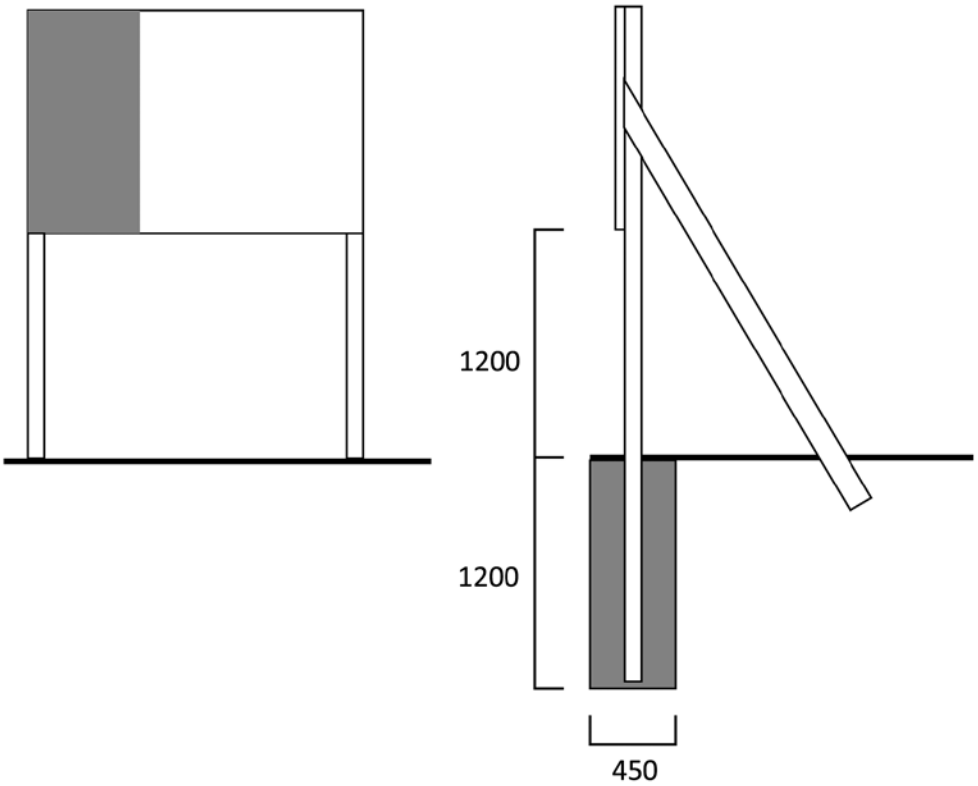
The Agency Safety and / or Occupational Health Manger POC will be provided at the pre-construction meeting.

-- END OF SECTION --

Construction Project Sign Dimensions (mm)

T1:	Text Group 1	Typeface: 150mm Large Standard Dari Font Color: White
T2:	Text Group 2	Typeface: 150mm Large Standard Dari Font Color: Black
T3:	Text Group 3	75mm Small Standard Dari Font Color: Black
T4:	Text Group 4	35mm Helvetica Bold, all capital letters Color: Light Yellow, matching GIROA logo
T5:	Text Group 5	35mm Helvetica Bold Color: Green, Pantone 370 PC
T6:	Text Group 6	45mm Helvetica Bold Color: Green, Pantone 370 PC

Mounting Diagram



Ministry of Interior

Government of the Islamic Republic of Afghanistan

ACTIVITY HAZARD ANALYSIS

ID No.	**FEATURE OF WORK:**	
Contract No.	**Project:**	**Location:**
Date:	**Activity:**	**Estimated Start Date:**
PRINCIPAL STEPS	**POTENTIAL SAFETY/HEALTH HAZARDS**	**RECOMMENDED CONTROLS**
Identify the principal steps involved and the sequence of work activities.	***Analyze each principal step for potential hazards.***	***Develop specific controls to eliminate or reduce each hazard to an acceptable level of risk.***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
List equipment to be used in the work activity.	***List inspection requirements for the work activity.***	***List training requirements, include hazard communication.***
Prepared by: Contractor's competent/qualified person(s) (Signature & Date)		
- AHA Accepted as Part of project Accident Prevention Plan; or **- This AHA has been reviewed by the designated AED COR and is acceptable for use on this project. This acceptance is predicated on satisfactory implementation in the field by the contractor and will be rescinded if the contractor fails to enforce the controls identified in this document and/or the requirements identified in EM385-1-1. This AHA will be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).**		**Name, COR (Signature & Date)**

C E R T I F I C A T E

OPERATION AND MAINTENANCE TRAINING VALIDATION

References: **1. Special Clause: Instructions and Training for Operations and Maintenance**
2. Technical Provision(s) _____

Equipment for which training conducted: _____

_____

_____

Description of Training:

1. Number of Classroom Hours: _____
2. Number of Hands-on Equipment Hours: _____
3. Location of Training: _____

Training Instructors: _____

Trainees: _____

_____

Contractor Certifying Official _____

Corps of Engineers Representative _____

User Acknowledgement _____

TAC Form 356
NOV 1999

Clearance Request Requirements Checklist
(Requirements as of 24 May 2010)

For use by all U.S. Army Corps of Engineers (USACE)/ Afghanistan Engineer District (AED) Contractors:
For questions, contact Nesar Asdaq at nesar_asdaq@yahoo.com; cell: (0093) 0700-276-349 or Customs Coordinator at DLL-CETAN-CAB@usace.army.mil.
Please make sure your set of documents contains the following prior to submitting to USACE/AED for Customs Clearance Process:
ALL DOCUMENTS DELIVERED TO AED-N QALAA HOUSE MUST BE ORIGINALS!

No	Item Name	Details
1	Cover Letter	To be on Company Letterhead; for more details please refer to Annex A (Sample Cover Letter Format)
2	Original Bill of Lading/CMR/Air Waybill ***(Verified copy of original is not acceptable)***	This document should include the following information in **English Language**: A. Document Number B. Date C. Consignee: (USACE, c/o Contractor Name & Address in Afghanistan) D. Contract # and Project Name (e.g W917PM……ANA Garrison…..) E. Route and Final Destination F. Container Number (if applicable) G. Truck Number (if applicable) H. Number of Pieces I. Description of Goods: 1) (if the goods are Vehicles/Loader/Excavators …etc) info should include: a) Engine # b) Chassis # c) Model d) Color e) Country of Origin f) Type/Brand 2) For non-mobile Machines like Generators only **Serial #** and **Brand or Type** is sufficient
3	Original Invoice ***(Verified copy of original is not acceptable)***	This document should include the following information in **English Language**: A. Document Number B. Date C. Consignee: (USACE, c/o Contractor Name & Address in Afghanistan) D. Contract # and Project Name (e.g W917PM……ANA Garrison…..) E. Container Number (if applicable) F. Description of Goods: 1) (if the goods are Vehicles/Loader/Excavators …etc) info should include: a) Engine # b) Chassis # c) Model d) Color e) Country of Origin f) Type/Brand 2) For non-mobile Machines like Generators only **Serial #, Brand or Type** is sufficient G. Currency in **USD** Only **(other currencies will not be accepted)** H. Invoice to be Signed & Stamped by Supplier
4	Packing List	To specify contents of Invoice (not required if invoice lists all items)
5	Certificate of Origin *(if applicable)*	Required only if cargo arrives in Afghanistan via Herat or Islam Qalah.
6	Exemption Form (MUAFFI NAMA)	To be obtained from Ministry of Finance (MOF) Revenue Department, and completed in the Dari Language

Note: For shipments coming through Pakistan – Karachi Port, we require two copies of the full set of documents in addition to the original documents: one copy for our office record and one copy for US Consulate Karachi– Pakistan. For shipments coming through Mazar e Sharif and Herat, only one copy for our office records suffices.

Sample Format for Letter of Introduction

TO: U. S. Army Corps of Engineers, Afghanistan Engineer District (AED)

ATTN: [name of POC]

FROM: Prime Contractor *(Authorized Person)*

SUBJECT: Customs Clearance Request for U. S. Military Equipment

Request your assistance in obtaining release of the following items, as we require their immediate shipment to Afghanistan for use in support of Operation Enduring Freedom (OEF).

Company:	Full Name and Address
Sub Contractor *(if applicable)*	Full Name and Address
Contract No & Task Order No.:	W912ER……., W917PM……..
Project Description:	i.e ANA Garrison Nangarhar, ANP Border Police Kandahar….etc
Shipping Route:	i.e Austria, Karachi – Pakistan, Torkham – Kabul or Turkey, Azerbijan, Turkmenistan, Herat …etc

Bill of Lading Details	Number Date	
	1234….	MM DD YY

Container Number:	TOLU4938862, TRLU5949846, TRLU9220744, AMCU4500861 etc…
Number of Pieces:	4 Containers
Contents:	Steel Pipe, Cement, Door, Window…etc *(if Vehicles or Generators, please refer to item (2-I or 3-F of Checklist**)*
Final Destination:	Kabul or Name of respective Province Afghanistan

Invoice Details	Number	Date	Amount	Currency
	123	MM DD YY	100,000.00	USD

Authorized Employee of Company responsible for Customs Clearance:	Name of Company's Employee
Authorized Shipping Agent:	Name and Address of Shipping Agent

Your cooperation in facilitating the clearance of said items from Afghan Custom's authorities and onward transportation to final destination is appreciated.

**If the contractor is importing its own equipment (e.g., vehicles, generators, etc.) for use on the contracted project, this statement is added: "The mentioned Equipment and Accessories are contractor-owned and are temporarily imported to Afghanistan for the contract period of _____ to _____. At the conclusion of the contract the said items will be removed from Afthanistan, or the original duties will be paid to the Afghanistan Customs Department, Ministry of Finance by the contractor.

Regards,

Name and Title of Authorized Person
Signature
Date
Stamp of Company

SECTION 01312

QUALITY CONTROL SYSTEM (QCS)

1. GENERAL

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site: the Contractor can obtain the current address from the Government. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration	Submittal Monitoring
Finances	Scheduling
Quality Control	Import/Export of Data

1.1.1 CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 OTHER FACTORS

Particular attention is directed to specifications “SUBMITTAL PROCEDURES”, “CONTRACTOR QUALITY CONTROL”, "PROJECT SCHEDULE", and Contract Clause, "Payments", which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available. It shall be the

responsibility of the contractor to maintain the QCS software and install updates as they become available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS. No separate payment shall be made for updating or maintaining the necessary hardware configurations necessary to run QCS:

Hardware

IBM-compatible PC with 1000 MHz Pentium or higher processor

256+ MB RAM for workstation / 512+ MB RAM for server

1 GB hard drive disk space for sole use by the QCS system

Digital Video Disk (DVD)-Compact Disk (CD) Reader-Writer (RW/ROM)

Monitor with a resolution of AT LEAST 1024x768, 16bit colors

Mouse or other pointing device

Windows compatible printer. (Laser printer must have 4 MB+ of RAM)

Connection to the Internet, minimum 56k BPS

Software

MS Windows 2000 or higher

QAS-Word Processing software: MS Word 2000 or newer

Internet browser supporting HTML 4.0 or higher

Electronic mail (E-mail) MAPI compatible

Virus protection software regularly upgraded with all issued manufacturer's updates

1.4 RELATED INFORMATION

1.4.1 QCS USER GUIDE

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 CONTRACTOR QUALITY CONTROL (CQC) TRAINING

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class. The government will provide QCS training if requested by the contractor.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached

to E-mail or via CD-ROM. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. Data updates to the Government shall be submitted via either E-mail or electronic media with printed/file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer a CD-ROM may be used instead of E-Mail (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 ADMINISTRATION

1.6.1.1 CONTRACTOR INFORMATION

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 SUBCONTRACTOR INFORMATION

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 CORRESPONDENCE

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 EQUIPMENT

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 MANAGEMENT REPORTING

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 FINANCES

1.6.2.1 PAY ACTIVITY DATA

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 PAYMENT REQUESTS

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 QUALITY CONTROL (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report.

1.6.3.1 DAILY CONTRACTOR QUALITY CONTROL (CQC) REPORTS.

QCS includes the means to produce the Daily CQC Report. The Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by specification 01451 “CONTRACTOR QUALITY CONTROL”.

1.6.3.2 DEFICIENCY TRACKING.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 THREE-PHASE CONTROL MEETINGS

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 ACCIDENT/SAFETY TRACKING.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports.

1.6.3.5 FEATURES OF WORK

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC REQUIREMENTS

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 SUBMITTAL MANAGEMENT

The Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 SCHEDULE

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Specification Section Project Schedule. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 REQUESTS FOR INFORMATION (RFI)

The Contractor shall use the two-way RFI system contained in QCS for tracking all RFI’s generated during the contract. Hard copies of all RFI’s shall be provided to the government, and will govern in the event of a discrepancy between electronic and printed mediums.

1.6.7 IMPORT/EXPORT OF DATA

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

-- END OF SECTION --

SECTION 01321

NETWORK ANALYSIS SCHEDULE

PART 1 GENERAL

1.1 DESCRIPTION

The network analysis schedule (NAS) shall consist of a cost loaded Critical Path Method (CPM) schedule and associated reports. The scheduling of all design, procurement and construction shall be the responsibility of the Contractor. All design, procurement and construction activities will be integrated in a single schedule. The schedule will start at NTP Acknowledged and end at Contract Completion. The schedule may extend beyond Contract Completion, for activities such as demobilization, with the approval of the Contracting Officer. The contractual period of performance will be shown as a hammock under Contract Milestones.

The approved NAS constitutes the baseline schedule and represents the contractor’s plan for executing the project. The schedule will be updated monthly to show current status. The monthly updates will be used to measure work progress, aid in the evaluation of requests for time extensions, and to provide the basis of all progress payments. All progress payment amounts will equal the earned values calculated in the monthly NAS updates.

For consistency, when scheduling software terminology is used in this specification, the terms in Oracle’s Primavera scheduling programs are used. Primavera Project Planner, P3, Primavera P6, and Primavera Contractor are registered trademarks or service marks of Oracle. Adobe and Acrobat are registered trademarks of Adobe Systems Incorporated.

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 will be submitted with Transmittal Form (ENG Form 4025) in accordance with Section 01335 SUBMITTAL PROCEDURES FOR DESIGN-BUILD PROJECT:

Preconstruction Submittals
- Scheduler Qualifications; G RE
- Project Execution Plan, G RE
- Activity Code Dictionary; G RE
- Baseline Network Analysis Schedule; G RE

With Pay Requests
- Monthly Network Analysis Schedule Updates; G RE

Closeout Submittals
- As-Built Schedule; G RE

1.3 SCHEDULE ACCEPTANCE

Review comments made by the Government on the Contractor's schedules will not relieve the Contractor from compliance with the requirements of the Contract Documents. The Contractor is responsible for scheduling, sequencing, and prosecuting the Work to comply with the requirements of the Contract Documents. The Government will review the schedule for compliance with the

contract (including contractual milestones and scope), cost loading and cost distribution, schedule organization and activity coding, logic, durations, and general conformance with established scheduling concepts and acceptable industry standards.

1.3.1 Schedule Acceptance Prior to Start of Work

The Baseline NAS described in paragraph 1.7.2 Baseline Network Analysis Schedule must be accepted by the Government before the Contractor will be allowed to request progress payments except for DBA as noted below in 1.3.2.

1.3.2 Acceptance

a. After the Baseline NAS is accepted by the Contracting Officer, it will be used by the Contractor for planning, organizing, and directing the work, reporting progress, and to support pay requests. The schedule will be updated monthly by the Contractor to reflect the current status of the work and will be submitted with the progress pay request. Processing pay requests is conditional upon receipt and acceptance of the Baseline NAS and accurate updated schedules accompanying the pay requests. Only DBA insurance will be paid prior to acceptance of the Baseline NAS.

b. The Baseline NAS and subsequent schedule updates will be considered to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor work plan, accurately reflects the work that has been accomplished, and the sequence in which it was performed.

1.4 SOFTWARE

The scheduling software that will be utilized by the Government on this project will be either Oracle’s Primavera P3 or Primavera P6. Notwithstanding any other provisions in the contract, schedules submitted for this project must be prepared using one of these programs. The program selected by the contractor will be used for the duration of the contract. The Contractor shall provide electronic files saved in compressed backup format (.prx or .xer) with all schedule submittals. If P6 is used, the contractor must provide the version number. Submission of data from another software system where data conversion techniques or software is used to import into Primavera's scheduling software is not acceptable and will be cause for rejection of the submitted schedule.

1.5 QUALIFICATIONS

The Contractor shall assign a Scheduler based in Afghanistan who will be responsible for the development, preparation, and maintenance of an accurate, computerized Network Analysis Schedule. The Scheduler shall perform on-site coordination, attend project meetings, prepare reports and perform updates as required to support the project. The Scheduler shall have previously developed, created and maintained computerized schedules for at least two projects similar in size and complexity to this contract. A resume outlining the qualifications of the Scheduler shall be submitted for acceptance to the Contracting Officer. If at a later date, the Contracting Officer considers the Contractor's Scheduler to be incompetent or objectionable, the Contractor will propose a new Scheduler who meets the qualification requirements. Payments will not be processed until an acceptable Scheduler is assigned.

1.6 SCHEDULE FORMAT

1.6.1 STRUCTURE

The NAS shall consist of a cost loaded CPM network displayed as time scaled bar charts supported by specified tabular and graphical reports. Sample standard reports are included in Appendix 01321a. The NAS will show the order and interdependence of activities and the sequence in which the work is planned to be accomplished. The basic concept of the network will be followed to show how the start and/or finish of a given activity is dependent on the execution of preceding activities and how it restrains the succeeding activities. Activity durations shall not be resource driven; activities shall not have date constraints, and shall start and finish according to network logic. Diagrams shall be organized with a four or five level work breakdown structure, sorted by Early Start and Early Finish Dates and will show a continuous flow from left to right. With the exception of the NTP Acknowledged and Contract Completion milestones, every activity must have predecessor and successor ties and every finish must have a successor. Activities with only start-to-start successor relationships will not be allowed. Activities in an accepted schedule may not be renamed or renumbered. Critical activities will be shown in red. Critical activities are defined as having zero or less days of Total Float. Near critical activities will be defined as having Total Float in the range of 1 to 14 calendar days. Barcharts will be submitted formatted for 11X17 sheets.

The following information will be shown for each activity:

a. Activity ID
b. Activity Description
c. Original Duration in Work Days
d. Remaining duration (schedule update reports only)
e. Early Start Date
f. Early Finish Date
g. Total Float
h. Budgeted Cost
i. Baseline Start Variance (schedule update reports only)
j. Baseline Finish Variance (schedule update reports only)

1.6.2 ACTIVITY PROPERTIES AND LEVEL OF DETAIL

Numbering shall be assigned so that, in general, predecessor activity numbers are smaller numerically than the successor activity numbers. Skip numbering shall be used on the network to allow insertion of additional activities for contract modifications and logic changes. All activities in RMS are sorted by activity ID.

Government Activities. All government activities shall be clearly identified in the schedule. Government activities include, but are not limited to; Government approved submittal reviews, Government conducted inspections/tests, environmental permit approvals, utility outages, Notice(s) to Proceed (including Notices to Proceed for each Fast-Track Phase as indicated in other sections of this specification and as directed by the Contracting Officer) and delivery of Government Furnished Material/Equipment. Show activities indicating Government furnished materials and equipment utilizing delivery dates indicated in "FAR 52.245-2, Government Property (Fixed-Price Contracts)". Government activities will be driven by a 7-day calendar, i.e. one with no non-work days.

Construction Quality Management (CQM) Activities. All activities will have a Definable Feature of Work (FOW) as identified in the Contractor's Quality Control Plan. The FOW will be entered in the FOW activity code as defined in the SDEF specification.

1.6.2.1 ACTIVITY BANDS

The schedule will use the following (phases=PHAS) as the first level of organization:

a. Milestones. This band contains the contract milestones. If the contractor includes other project milestones, contract milestones and project milestones will be shown as separate bands below MILESTONES.
b. Pre-Construction. Included in this band are pre-construction meetings and submittals. Pre-construction submittals will be shown as a separate band under PRE-CONSTRUCTION.
c. Design. This band contains activities related to site investigation, surveys and design including, but not limited to Design Notice to Proceed, Contractor's design by design phase, application for and receipt of required permits, Contractor's constructability reviews, submittal of design packages to Government, Government's design review periods, specified design meetings, transition periods prior to Construction Notice to Proceed, (including Notice to Proceed for each Fast-Track Phased Design as indicated in Section 01335 SUBMITTAL PROCEDURES FOR DESIGN/BUILD PROJECT and as directed by the Contracting Officer). The Government review period shall be from the time the design is received by the Government to the time it is sent back to the Contractor, in calendar days. Design activities will be linked to their associated Submittal, Procurement, and/or Construction activities. If the Government's review of any submittal requires resubmission or does not clear the design for construction, a new series of Design Activities will be inserted into the schedule. The predecessor for the new design preparation activity will be the original approval activity and the successor will be the beginning of the next design phase.
d. Procurement. This band contains tasks related to the procurement of installed material or equipment including but not limited to material submittal preparation, submittal and approval, fabrication, delivery, extra stock, special tools, O&M manuals, notification of Government Furnished Material/Equipment delivery requirement. As a minimum, separate procurement activities will be provided for every specification section. Submittal approval activities shall be logically tied to associated procurement, delivery, and/or construction activities. If the contractor requires payment upon delivery for materials or equipment, i.e. “stored materials”, a one day activity must succeed the delivery activity. The activity description should be “Stored Materials: name of materials or equipment”. The activity will carry the documented cost of the materials or equipment and will be statused as actual only after review and approval of the supporting documentation by the COR. Payment for stored materials if allowed by the contract is subject to approval by the Contracting Officer and must be requested in writing prior to submittal of the baseline schedule. If the Government's action on any submittal is "Disapproved" or "Revise and Resubmit", a new series of Submittal Activities will be inserted into the schedule. Predecessor for the new submittal preparation activity will be the original approval activity and the successor will be the fabrication/deliver activity for the equipment or material.

e. Construction. This band will have as many subordinate bands as are required to provide a logical organization of construction work. These bands will contain all construction activities including but not limited to mobilization, demobilization; installation of temporary facilities tradesman; testing and inspection of installed work; start-up and testing of equipment; commissioning of building and related systems; scheduling of specified manufacturer's representatives. No construction activity shall have a duration greater than 20 working days. Construction activities will be driven by calendars that reflect all scheduled non-work days, i.e. Fridays, official Afghan holidays and severe weather days as listed in section 01060 of the contract.
f. Contract Closeout. This band will have two or more subordinate bands to provide a logical organization of the closeout work. These bands will contain all closeout activities including but not limited to Punch Out Inspection, Pre-Final Inspection, Final Acceptance Inspection, final clean-up. as-builts, O&M manuals and training.

1.6.2.2 PROJECT MILESTONES

The NAS will include milestones for the start of the project; any contract required interim start and completion dates, contract completion date and other significant milestones. Only Contract Milestones will be recognized by the Government.

a. NTP Acknowledged: The schedule shall start no earlier than the NTP Acknowledged Date. NTP Acknowledged will be shown as a start milestone with a start-no-earlier-than constraint date equal to the date shown in RMS.
b. Contract Complete: The last activity in the schedule will be the Contract Complete milestone. This milestone will have finish-no-later-than constraint date equal to the Contract Required Completion date in RMS.

1.6.2.3 MANDATORY ACTIVITIES

The following activities, and the procurement activities described in 1.6.2.1d, when applicable, shall be listed as separate activities:

a. Submission, review and approval of the demining plan and required demining activities through receipt of the certificate.
b. Submission and approval of the accident prevention plan.
c. Submission and approval of the security plan.
d. Submission and approval of the contractor quality control plan
e. Submission and approval of the design quality control plan
f. Submission and approval of the area use plan.
g. Mobilization
h. Demobilization
i. Submission, review and acceptance of design packages and all related activities required to support design.
j. Submission and approval of mechanical/electrical layout drawings.
k. Submission and approval of O & M manuals.
l. Submission and approval of as-built drawings.
m. Submission and approval of 1354 data and installed equipment lists.
n. Submission and approval of testing and air balance (TAB).
o. Submission of TAB specialist design review report. Submission and approval of fire protection specialist.
p. Submission and approval of testing and balancing of HVAC plus commissioning plans and data.

q. Air and water balance dates.
r. HVAC commissioning dates.
s. Controls testing plan.
t. Controls testing.
u. Performance Verification testing.
v. Other systems testing, if required.
w. Pre-final inspection.
x. Correction of punch list from pre-final inspection.
y. Final inspection.

1.6.2.4 ACTIVITY NUMBER (ID) AND DESCRIPTION

a. Activity Numbers: Activity numbers will consist of up to 10 alphanumeric characters beginning with a letter and ending with a number. Only letters and numbers will be used. Activities must be numbered in ascending order from start to finish of the project.
b. Activity ID Codes: The Contractor shall submit the alphanumeric coding scheme for Activity Numbering that shall be used throughout the project. Activity ID Codes may be used to create a work breakdown structure (WBS). Four Activity ID fields are allowed in P3; user defined fields may be used in P6. The coding dictionary shall include the value and description of each code. Once accepted, the coding scheme will be used for the duration of the project. PHAS and AREA are the top two levels of codes.
c. Activity Description: Each activity shall have a narrative description consisting of a Location (e.g.; Building 1, 3rd floor, northeast quadrant, basement – abbreviate as necessary), Verb (e.g.; form, pour, excavate), and Object (e.g.; slab, footing, under floor plumbing).

1.6.2.5 ACTIVITY CODE DICTIONARY AND VALUES

The Contractor shall use the activity coding structure defined in USACE Regulation ER 1-1-11 Standard Data Exchange Format (SDEF) Appendix 01321a. The use of this exact structure is mandatory, even if some fields are not used. The SDEF fields may be used only for the purpose for which they are intended. The characters remaining after the SDEF codes are limited to eight in Primavera P3. These activity codes may be used to replace or supplement the Activity ID Codes. The codes will have values assigned that will allow the scheduling program to sort, select, group and organize the activities in the schedule.

Activity codes are used to:

1. Group and summarize project activities in a hierarchical structure, in the same way as a work breakdown structure (WBS), to facilitate updating and analysis of the schedule.
2. Group and summarize activities and related costs by CLIN and Bid Item
3. Select and sort activities to create ad hoc views and reports

1.6.2.6 COST AND RESOURCE LOADING

a. Cost Loading Activities:
- Payment for design work will be made after a design submittal is approved. The cost of the design submittal will be applied to a one day “Design Approved” task after the AED approval activity.

- Payment for mobilization and demobilization shall be paid according to the approved CLIN amount for these items. Unless specified otherwise in the contract, then the amount shall be split 60 percent for mobilization and 40 percent for demobilization and each of these costs applied to these separate cost loaded activities.
- The cost of installed materials and equipment will be included in the appropriate construction activities except as allowed by the contract and where the Contracting Officer agrees in advance to payment for stored materials.
- If payment is allowed by the Contracting Officer for stored materials, the cost of the stored materials will be applied to a one day “Stored Materials Accepted” activity after the delivery activity.
- Unless assigned a CLIN, indirect costs such as management, supervision, security, overhead, G&A and profit will be included in each activity budget. The total of all cost loaded activities shall equal the value of the contract.
- Cost shall be rounded to zero decimal places if the contract and CLIN costs are in whole dollars. Cost shall be assigned to activities as a resource as described in the QCS requirements for SDEF file transfer.
- Hammocks (summary bars) will not be cost loaded.
- CLINs and resources will not be entered for activities with no budget.

b. Cost Loading Milestones: Milestone activities may not be cost loaded. A one day task should be used in instead of a cost loaded milestone such as Design Approved or Stored Materials Accepted.
c. Contract Line Item Number (CLIN): As described in Cost Loading, cost shall be assigned to every task type activity. Every activity shall also be assigned to a CLIN. All cost and earned value reports will be grouped by Project and CLIN with sub groups as appropriate. Group totals will be shown for Project and CLIN.
d. Key Quantities: Key quantities will be included as a resource for all cost loaded construction activities. Resource units of measure and cost per unit will be set up in the resources table. Key quantity resources will be non-driving
e. Labor Resource Loading: As part of the Baseline Schedule development each construction activity shall have an estimate of the number of workers per day by trade, hours per day by trade and total expected hours used by trade during the execution of the activity. If no workers are required for an activity, then the activity shall be identified as using zero workers per day. All labor resources loaded into the schedule shall be non-driving and will not be used to calculate activity cost or duration. Resource leveling shall not be used. Actual labor resource expended on an activity will be recorded in the monthly updated schedules and will coincide with entries made in the Daily Reports.

1.6.2.7 CALENDARS

Three calendars will be used in preparing the schedule:

1. 7 day week, no weekends or holidays, and no weather (7 Day Calendar) This calendar is used for any activity whose duration is measured in consecutive calendar days. These activities are mainly in the design and procurement phases. Examples are AED design review, fabricate & deliver.
2. 6 day week, with non work weekend days, and public holidays, no weather (Standard Calendar)

This calendar is used for construction activities which are not affected by severe weather conditions. Examples are all interior work and above ground structural work which is not temperature sensitive such as structural steel erection. Some activities may require interior heating in cold weather for example, painting and plastering.

3. 6 day week with public holidays and severe weather days as listed in Section 01060 Special Clauses (Weather Calendar)
   This calendar is used for construction activities which cannot or will not be performed in severe weather conditions (such precipitation, high or low temperature, wind), such as earthwork, excavation, compaction, concrete work, exterior plastering.

If the site is shut down for any reason, for example severe weather or adverse security conditions, the shut down periods will be shown as non-work days on Calendars 2 and 3. Site shutdowns will be documented in the EWP (paragraph 1.7.3b).

Although the use of additional calendars is not recommended, the contractor may submit other calendars for AED approval.

Afghan Public Holidays
All calendars except Calendar 1 must show official Afghan holidays as non-work days. The dates for 2011 are listed below. The dates of Muslim holidays regress 11 days every year. This rule may be used to estimate the holiday dates for future years.

2011

1.	Feb.15	Liberation Day
2.	Feb.15	The Prophet’s Birthday*
3.	Mar.21	Nauruz (Afghan New Year)
4.	Apr.18	Liberation Day
5.	Apr.28	Victory Day
6.	May 1	Labor Day
7.	Aug.1	Start of Ramadan – approximate*
8.	Aug.19	Independence Day
9.	Aug.30	Eid al Fitr (End of Ramadan)*
10.	Sep.1	Eid al Fitr Holiday*
11.	Sep.2	Eid al Fitr Holiday*
12.	Nov.6	Eid al Adha (Feast of the Sacrifice)*
13.	Nov.7	Eid al Adha Holiday*
14.	Nov.8	Eid al Adha Holiday*
15.	Nov.9	Eid al Adha Holiday*
16.	Dec.27	Ashura*

Notes:

Holidays marked ** are observed according to the Muslim calendar. Dates are tentative. The calendar should be adjusted as required to reflect official announcements for each calendar year within the project schedule.

The month of Ramadan is not included in the construction calendar as non-working time. It should be borne in mind, however, that during this month productivity and availability of manpower tend to be lower than normal. This should be taken into consideration when scheduling work during this period.

1.6.2.8 SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS

Activity Constraints: Date constraints other than those required by the contract will not be allowed unless accepted by the Contracting Officer. The contractor will identify any constraints proposed and provide an explanation for the purpose of the constraint in the Narrative Report.
Lags: Lags will not be used in place of activities in the logic. For example concrete curing time must be shown as an activity, not as a lag between the activities Pour Concrete and Remove Formwork. Negative lags must not be used. The contractor will identify all lags and provide an explanation for the purpose of the lag in the Narrative Report.

Actual Dates: Actual start and finish dates shall not be automatically updated by default mechanisms that may be included in the scheduling software. Actual Start and Actual Finish dates on the CPM schedule must match the dates in the Daily QC Report. These reports will be the basis for updating actual dates in the schedule.

Percent Complete: The reported percent complete of an activity will be based on the quantity of acceptable work in place.
Actual Hours: The schedule will be updated with actual labor hours as reported in the Daily QC Reports.

Software Settings for Primavera P3: Use the P3 defaults for settings which are not otherwise specified. Settings may only be changed with the contracting officer’s approval.

Project Overview:
- Set decimal places to zero if all CLIN values are in whole dollars
- Set Project Start to NTP Acknowledged Date
- Set Project Must Finish By to Contract Required Completion date

Schedule/Level Calculation Options:
- Automatic scheduling and leveling – off
- When scheduling activities apply – retained logic
- Calculate start-to-start lag from – early start
- Schedule durations – contiguous
- Show open ends as - noncritical
- Calculate total float as – finish float

Autocost Rules:
- Uncheck Link Remaining Duration and Schedule Percent Complete
- Check Freeze Resource Units per time period

Summarization:
- Default calendar is 1 (7-day calendar)
- Weighting factor for calculating percent complete is by cost

Critical Activities: Critical activities are activities which have zero or negative total float. The critical path is as calculated by the software longest path.

Format:

Bars: Activities will be shown as bars with no start and end points. Relationship lines will not be shown unless required for a specific report. Activity descriptions will be shown to the right of the bar. Target bars will be shown as a thin black bar above the current schedule. Progress will be shown based on percent complete.

Timescale: The timescale will show calendar dates with the minimum unit being weeks.

Vertical Sight Lines: The major and minor vertical sight lines will generally be months and weeks, respectively. For short term reports such as the 3-week look ahead, the increments will be week and day.

Fonts: The default font will be Arial 10.

Dates: The date format will be ddMMMyy. For example, 12JAN10.

Activity type: The default activity type is "Task".

Activity Number Increment: The initial activity number increment will be 10 to allow inserting activities in sequential order.

Store Period Performance: Upon completion of each monthly update, period performance must be stored in order to preserve historical cost distribution.

Software Settings for Primavera P6: Use the P6 defaults for settings unless otherwise stated for P3 above. Settings may only be changed with the contracting officer’s approval.

Out-of-Sequence Progress: Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be not be allowed. The Contractor shall make logic corrections to reflect the as-built construction sequence.

1.6.2.9 FILE NAME

Each schedule submitted must have a unique name. The schedule ID will consist of four alpha-numeric characters.

- The first character is assigned by the contractor to uniquely identify a USACE contract. It may be a letter from A to Z. The numbers 0 to 9 may be used if the contractor needs to identify more than 26 USACE contracts.
- The second character is B (for Baseline or C for Current update).
- For a baseline schedule the third character is the baseline number and the fourth character is the submittal number. For example, the second submittal of the initial baseline would be 12.
- For a current update the third and fourth characters are the update sequence number from 01 to 99.
- Example baseline schedule ID: AB12 for contract A, initial baseline, second submittal
- Example current update: AC12 for contract A, current update No.12

1.6.3 REQUIRED REPORTS

The following reports will included with the specified schedule submittals. A PDF of each report will be included on the CD submitted by the Contractor. Barchart reports will be saved as layouts. Tabular and graphical reports will be saved as report specifications. All redundant layouts, report specifications and filter specification will be deleted from the project before it is transmitted.

BASELINE SCHEDULE

a. Project Schedule Report. This is a barchart showing all activities organized by WBS and sorted by early start and early finish.
b. Cost Report. This is a barchart showing budget totals by CLIN.
c. Critical Path Report. This is a barchart showing activities on the longest path. The report layout will be the same as the Project Schedule Report.

UPDATE SCHEDULE

These reports will be submitted with the monthly pay request.
a. Project Schedule Report. This is a barchart showing all activities organized by WBS and sorted by early start and early finish. This report will display the baseline and current update on separate bars.
b. 3 Week Look Ahead. This is a barchart showing activities in continuing or scheduled to start or finish in the three week period after the data date.
c. Earned Value Report. This is a barchart listing all activities which have an earned value. The report will be organized by CLIN and WBS, sorted by early start and early finish.
d. Critical Path Report. This is a barchart showing activities on the longest path. The report layout will be the same as the Project Schedule Report.
e. Other Reports – Reports necessary to monitor and evaluate the project shall be provided by the contractor as requested by the COR.

1.7 SUBMISSION AND ACCEPTANCE

1.7.1 PRELIMINARY MEETING

Before the contractor begins preparation of the initial Baseline Network Analysis Schedule, the Contracting Officer, the Contractor and the AED scheduling consultant shall participate in a preliminary meeting to discuss the proposed schedule and the requirements of this section.

1.7.2 BASELINE NETWORK ANALYSIS SCHEDULE

Once review comments are resolved and the Contracting Officer has accepted the Baseline Network

Analysis Schedule, the contractor shall furnish the following within 5 calendar days:

a. Two copies of the reports listed in the paragraph entitled "Required Reports".
b. Two copies of the Cost Loading S-Curve and Histogram indicating the cost loading based upon both early and late dates.
c. Two sets of CDs containing an electronic file of the project schedule along with a PDF print copy and required reports shall be provided for the initial submission and every periodic project update. A permanent label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Baseline, Update, Recovery, Change, etc.), full contract

number, Project Name used to identify project in scheduling software, contract name & location, data status date, diskette number with total number of diskettes in set, software name and version used to run the schedule, and the name and telephone number of person responsible for the schedule.

d. The schedule reports shall include a footer which shows the contractor name, contract number, contract title, project ID and data date. A sample footer will be provided at the preliminary meeting.

1.7.3 PROJECT EXECUTION PLAN

a. Initial Work Plan

The purpose of the Initial Work Plan (IWP) is to ensure that the contractor understands the scope of work and demonstrates that the project has been properly planned to be executed within the period of performance. The IWP is prepared and submitted with the baseline schedule. It supplements and explains the baseline schedule.

The IWP must conform to the following outline:

- Introduction
  - Scope of work
  - Period of performance
  - Location
  - Climate and topography
- Management Plan
  - Non-manual (management and supervision) staffing
  - Mobilization and demobilization
  - Security: on-site and transportation
  - Logistics
- Engineering and Design
  - Performed by whom and where
  - Design submittals
  - Constraints on procurement
  - Constraints on construction
  - Partial releases for construction, if required
- Procurement
  - Materials submittals
  - Long lead or critical materials and equipment: sources and lead times
  - Constraints on design and construction
- Subcontracting
  - Subcontracting plan
  - Subcontractor resources
- Construction
  - General sequence of construction
  - Schedule allowances for Ramadan, holidays and weather (defer work to favorable weather; methods for cold weather concrete, etc.)
  - Critical constraints on construction

- Labor and equipment constraints
- Construction methods: for example machine excavation vs. hand excavation, pre-fabricated steel vs. on-site fabrication, in-situ vs. precast concrete
- Productivity calculations used for the work durations for all major trades
- Materials testing and quality control

b. Execution Work Plan

The Execution Work Plan (EWP) is an update of the IWP incorporating any issues which could affect performance of the work. The EWP must be revised if there is a significant change in scope or site conditions, or if there is a delay in the schedule. As part of the contract closeout, the EWP will be revised to document how the work was executed.

1.7.4 MONTHLY NETWORK ANALYSIS UPDATES

The Contractor and Government representatives will meet monthly to review and agree on the status of each activity after which the contractor shall update the project schedule with the agreed on percentages for each activity progressed during the update period. The purpose of the meeting is to determine progress payment amounts for each activity, allow all parties to evaluate project status at the data date, provide a complete and accurate update of procurement and construction progress, create an historical record of the project and forecast contract completion based upon current status. The contractor is responsible to gather all supporting documentation, present the update data for the schedule and record the meeting minutes. All progress payment amounts will be derived from and tied to the cost-loaded schedule activities. Submit at monthly intervals a report of the actual construction progress by updating the required reports and the time scaled bar charts. Meeting to update the schedule and the submission of an error free, acceptable updated schedule to the Government is a condition precedent to the processing of the Contractor's pay request. As a minimum, the following actions will be accomplished during the meeting:

a. Identify activities started and completed during the previous period and enter the Actual Start and Actual Finish dates. It will be understood that Actual Start is defined as the date that work begins on an activity with the intent to pursue the work represented by the activity to substantial completion, and Actual Finish is defined as the date that the activity's work is substantially complete to the point that its successor activity(s) may begin. Actual dates must agree with the daily reports.
b. Show estimated duration (in workdays) to complete each activity started but not completed (remaining duration). Forecast finish dates may not be on the data date.
c. Show forecast start dates. Forecast start dates may not be on the data date.
d. Update the percent of work complete for activities which are in progress or have been completed.
e. Reflect changes in the network diagram. All changes (i.e., remaining duration changes, logic changes, new logic, conformed change orders, new activities, changes due to Conformed Modifications, changes in work sequence, entry of as-built relationship logic, etc.) shall be recorded

and a note added to the activity log field. The log shall include as a minimum, the date and reason for the change, and description of the change. All changes to the schedule shall be clearly identified and explained in the monthly narrative report.

f. A complete update of the project schedule containing all approved progress, revisions, and adjustments shall be submitted by the10th of each month to allow adequate time for review and for the contractor to perform any necessary revisions prior to submittal of the updated schedule with the monthly pay request. The progress reported on the updated schedule shall be consistent with and in support of the information reported on the pay request. Processing of the monthly pay request shall be dependent upon the accompanying receipt of an acceptable progress schedule.

g. The Narrative Report will include:
   - Progress made in each area of the project
   - Changes in the following: activities, original durations, logic interdependencies, milestones, planned sequence of operations, critical path, and resource and loading
   - Pending items and their status including permits, change orders, and time extensions
   - Status of Contract Completion Date and interim milestones
   - Current and anticipated delays (describe cause of the delay and corrective action(s))
   - Discussion of the critical path
   - Description of current and future schedule problem areas
   - Forecast of expected progress in each area of the project for upcoming reporting period or the following 30 calendar days. Each entry in the narrative report will cite the respective Activity ID and Activity Description.

h. Submit two copies of the reports listed in the paragraph entitled "Required Tabular Reports".

i. Submit two hard copies of the network diagrams and two sets of data disks.

j. Submit two copies of the Update Meeting minutes.

1.7.5 RECOVERY PLAN

In the event the contractor falls 20 or more work days behind schedule then the contractor will be required to submit a recovery plan (schedule and a detailed narrative) describing the steps that will be taken to recover the lost time and return the critical path of the project to at least zero days total float. The contractor shall submit the recovery plan within 7 calendar days of submitting a periodic schedule update that indicates the contractor is 20 or more work days behind schedule. The detailed narrative shall be an update of the Execution Work Plan and will provide a full explanation of the recovery schedule.

1.7.6 QCS INTERFACE

Data from Primavera P3 and P6 can, and should be, transferred to QCS using SDEF. Eliminating manual entry of this data into QCS will reduce errors, ensure that data in QCS is keyed to the correct schedule activities and eliminate the cost of data entry. Refer to ER-11-1-1 and the Exchanging Data chapter in the QCS User Manual.

1.7.7 AS-BUILT SCHEDULE

As a condition for the release of retention and making final payment, the Contractor shall submit an "As-Built Schedule", which is the last schedule update. The As-Built Schedule shall reflect the exact manner in which the project was actually constructed (including actual start and finish dates, activities, sequences, and logic) and shall be certified by the Contractor's Project Manager and Construction Scheduler as being a true reflection of the way the project was actually constructed. If more than one person filled the position(s) during the course of the project, each person will provide certification for the period of time they were responsible.

1.8 CONTRACT MODIFICATION

When a contract modification is required, the contractor shall submit proposed revisions to the network with a fragnet and a cost proposal for each proposed change. A narrative and all supporting documentation shall be included with the fragnet and cost proposal. All modifications shall be incorporated into the network analysis system as separately identifiable activities broken down and inserted appropriately on the first update following issuance of a directive to proceed with the change. Submit two copies of the Total Float Report, Log Report and a copy of the proposed Time Impact Analysis on disk, with the cost proposal no later than 14 days after the incident (if a delay issue) or after receiving written direction to proceed. Unless the Contracting Officer requests otherwise, only conformed contract modification fragnets will be added into the subsequent monthly updates. All revisions to the baseline schedule that are necessary to further refine the schedule so that the changed work activities can be logically tied to the schedule shall be made. Financial data shall not be incorporated into the schedule until the Contracting Officer signs the contract modification.

1.8.1 Time Impact Analysis:

The Time Impact Analysis method shall be used by the Contracting Officer and the Contractor in determining if a time extension or reduction to the contract milestone date(s) is justified. The Contractor shall provide a Time Impact Analysis to the Contracting Officer for any proposed contract change or as support for a Value Engineering Proposal, Variance Request, Claim or Request for Equitable Adjustment by the Contractor. The Time Impact Analysis schedule must be submitted on disk and a printed /plotted hardcopy. A narrative and all supporting documentation shall be included with the fragnet and cost proposal.

a. The Contractor shall submit a Time Impact Analysis illustrating the influence of each change or delay on the Contract Completion Date or milestones. Unless the Contracting Officer requests an interim update to the schedule, the current monthly updated schedule accepted by the Government shall be used to display the impacts of the change. Unless requested by the Contracting Officer, no other non-conformed changes will be incorporated into the schedule being used to justify the change impact.
b. Each Time Impact Analysis shall include a Fragmentary Network (fragnet) demonstrating how the contractor proposes to incorporate the impact into the project schedule. A fragnet is defined as the sequence of new activities and/or activity revisions, logic relationships and resource changes that are proposed to be added to the existing schedule to demonstrate the influence of impacts to the schedule. The fragnet shall

identify the predecessors to the new activities and demonstrate the impacts to successor activities. The Contractor shall provide a hardcopy printout of the fragnet activities and relationships being added and also insert the fragnet into the most current, accepted Monthly Network Analysis Update, run the schedule calculations and submit the impacted schedule with the proposal, claim, etc. Include a narrative report describing the effects of new activities and relationships to interim and contract completion dates, with each Time Impact Analysis. Submit tie extension requests with a Time Impact Analysis and three hardcopies of the fragnet, impacted schedule (with fragnet loaded), Total Float Report, Narrative Report and Log Report.

c. Following the Contractor's receipt of a contract modification on a Standard Form 30 signed by the Government; all changes in the fragnet used to determine impacts, shall be incorporated into the schedule. Changes will occur during the next monthly schedule update meeting.

1.8.2 NO RESERVATION-OF-RIGHTS

All direct costs, indirect costs, and time extensions will be negotiated and made full, equitable and final at the time of modification issuance.

1.9 CHANGES TO THE NETWORK ANALYSIS SCHEDULE

If changes in the method of operating and scheduling are desired, the Contracting Officer shall be notified in writing stating the reasons for the change. If the Contracting Officer considers these changes to be of a valid nature, the Contractor may be required to revise and submit for acceptance, without additional costs to the Government, the network diagrams and required reports. A change may be considered of a major nature if the estimated time required or actually used for an activity or the network logic has varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion date(s). Changes that affect activities with adequate float time shall be considered a major change when their cumulative effect would extend the contract completion date.

1.10 FLOAT

Use of float suppression techniques, such as; preferential sequencing (arranging critical path through activities more susceptible to Government caused delay), unjustifiable relationship lags, zero total or free float constraints, extended activity times, or imposing constraint dates other than as required by the contract, shall be cause for rejection of the project schedule or its updates. The use of Resource Leveling (or similar software features) used for the purpose of artificially adjusting activity durations to consume float and influence the critical path is expressly prohibited.

1.10.1 DEFINITION OF FLOAT

Free Float is the time the start of an activity can be delayed without delaying the start of a successor activity. Total Float is the time finish of activity can be delayed without delaying the project completion date. Project Float is the length of time between the Contractor's Forecast Early Completion and the Contract Required Completion.

1.10.2 OWNERSHIP OF FLOAT

Float available in the schedule, at any time shall not be considered for the exclusive use of either the Government or the Contractor. During the course of the project, any positive float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather is less than expected, will also contribute to the reserve of float. A schedule showing work completing in less time than the contract time, and accepted by the Government, will be considered to have Project Float. Project Float will be a resource available to both the Government and the Contractor. No time extensions will be granted nor delay damages paid unless a delay occurs which impacts the project's critical path, consumes all available float or contingency time, and extends the work beyond the Contract Required Completion Date.

1.10.3 NEGATIVE FLOAT

Negative float will not be a basis for requesting time extensions. Any extension of time will be addressed in accordance with the paragraphs entitled "CONTRACT MODIFICATION". Scheduled completion date(s) that extend beyond the contract or phase completion date(s) may be used in computations for assessment of payment withholdings. The use of this computation is not to be construed as a means of acceleration.

1.11 3 WEEK LOOK AHEAD SCHEDULE

The 3-Week Look Ahead Schedule provides a focus on the day-to-day planning and execution of near term work. This schedule is filtered from the NAS and shows activities which fall in the period extending from one week before the data date to three weeks after the data date. This schedule will use the standard barchart format described under Current Schedule Update. Two bars will be shown to allow comparison of the current week update with the previous week’s schedule. The report will, formatted for printing on 8 ½ by 11 sheets. A pdf of the 3-week schedule shall be emailed to the Contracting Officer at least 3 work hours prior to the start of the weekly coordination meeting.

1.12 WEEKLY COORDINATION MEETING

A coordination meeting will be held each week to discuss the near term work as shown on the 3-Week Look Ahead schedule. The contractor will present an overview of the previous week's work, the current week's work, and the work planned for the following two weeks. Items which should be discussed are changes in the 3-week schedule. Issues which affect execution of the work such as coordination, procurement, labor and equipment. The Contractor will take meeting minutes. All meeting minute entries will be keyed to the schedule activity numbers) being addressed. Within one day of the meeting, the Contractor will provide a draft copy of the meeting minutes to the Contracting Officer for review and comment. Final copies of the minutes containing the comments provided by the Contracting Officer will be issued within 3 days of the meeting.

1.13 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs, etc.) and test reports (e.g., concrete, soil compaction, weld, pressure, etc.) shall reference the Schedule Activity Number(s) that are being addressed.

-- End of Section --

SECTION 01321a

APPENDIX TO 01321

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description
Standard Schedule Template	
+ Major Milestones	
Engineering & Design	
B002130	65% Design - AED review & approve package
Procurement	
Electrical	
Transformers	
C001000	Purchase Transformers
C001010	Transformers Ordered
C001100	Deliver Transformers
Generators	
C001000A	Purchase Generators
C001010A	Generator Ordered
C001100A	Deliver Generators
Electrical Panels	
C001000B	Purchase Electrical Panels
C001010B	Electrical Panels Ordered
C001100B	Deliver Electrical Panels
+ Construction	

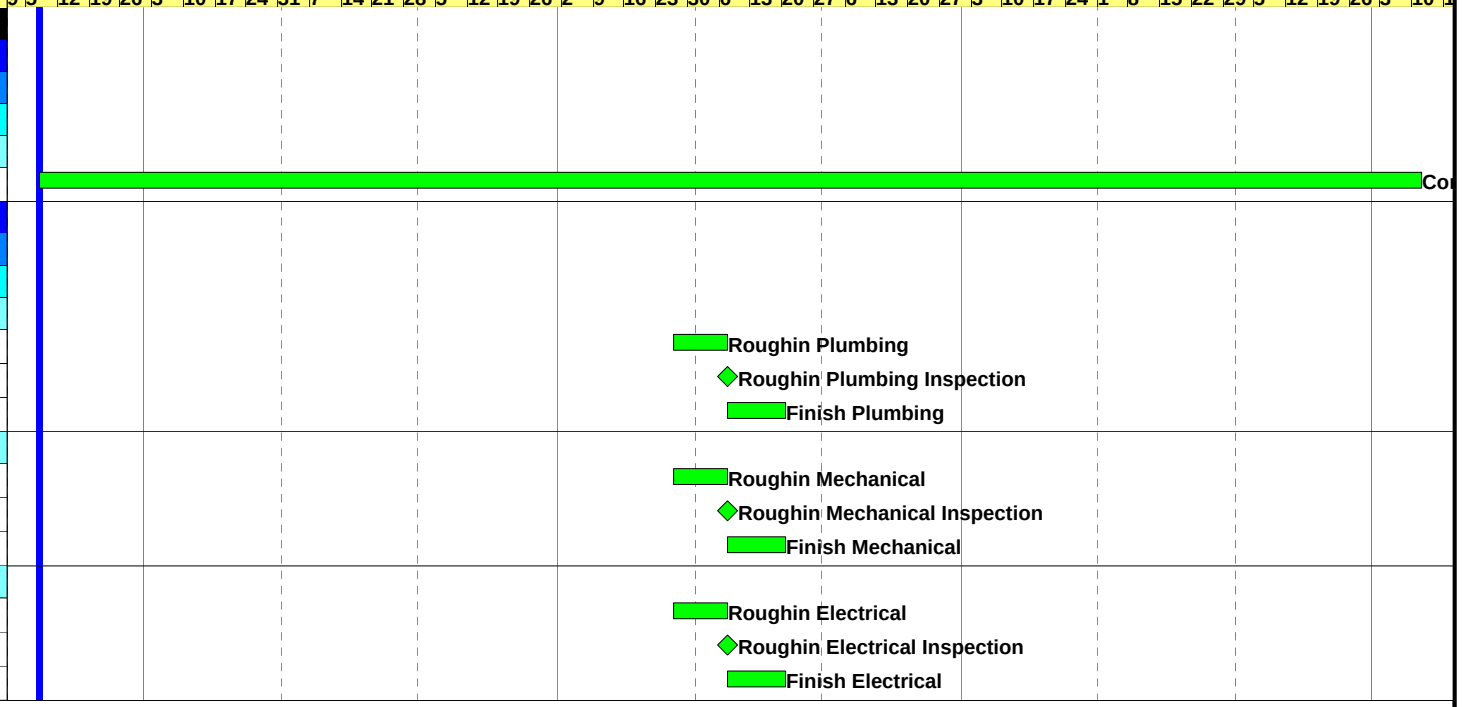
SAMPLE

Procurement of Long Lead Electrical Items
Orders Must be Placed by 35% of POP

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description
Standard Schedule Template	
Major Milestones	
A001050	Contract Duration
Construction	
Buildings	
Building 1	
Plumbing	
E001080	Roughin Plumbing
E001120	Roughin Plumbing Inspection
E001130	Finish Plumbing
Mechanical	
E001100	Roughin Mechanical
E001140	Roughin Mechanical Inspection
E001150	Finish Mechanical
Electrical	
E001090	Roughin Electrical
E001160	Roughin Electrical Inspection
E001170	Finish Electrical



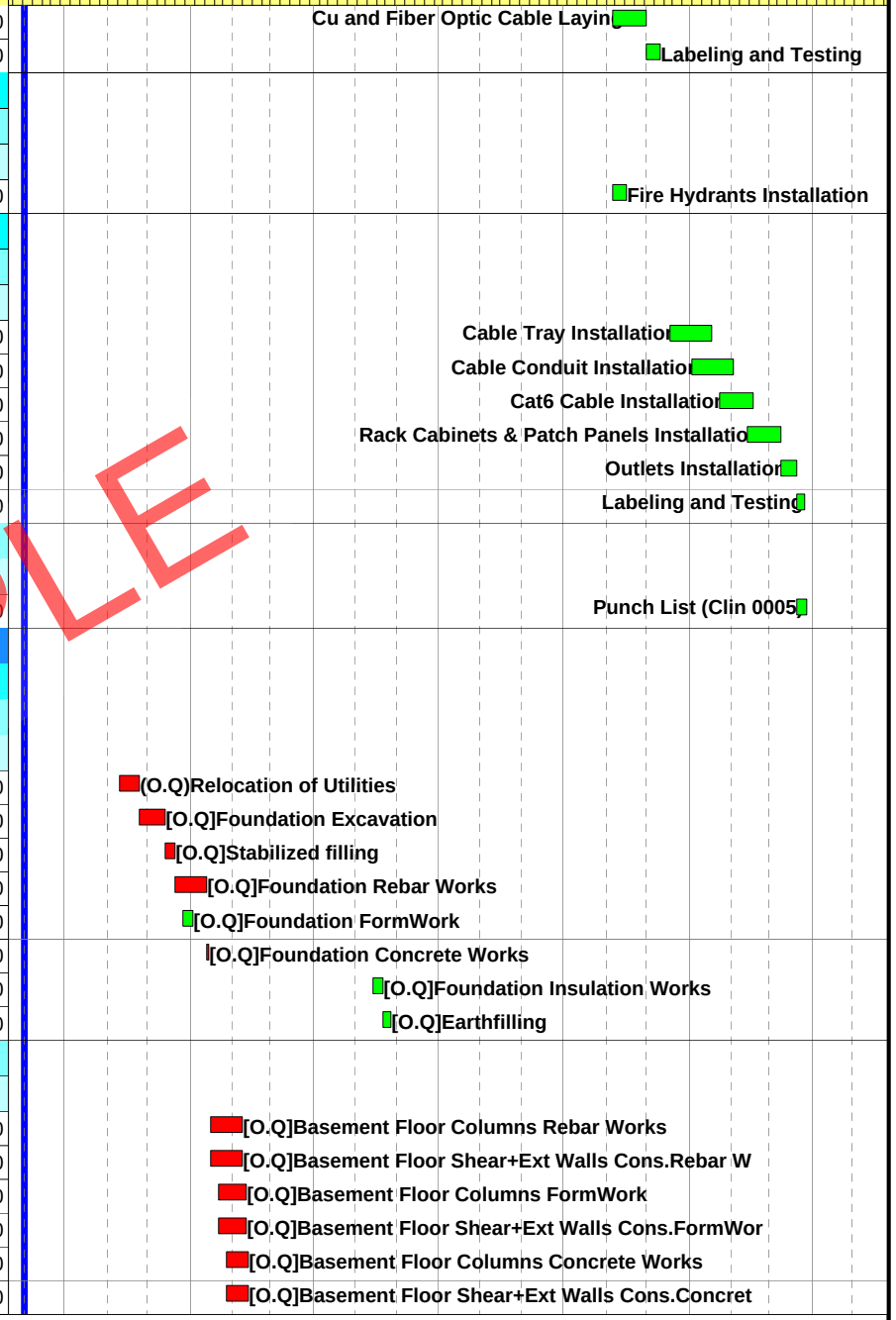
SAMPLE

Roughin Inspections Must be Completed
Before Finish Work Begins

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
005890	Cu and Fiber Optic Cable Laying	25	06NOV10	30NOV10	97	0
005900	Labeling and Testing	10	01DEC10	10DEC10	97	0
Fire Water System						
005370	Fire Hydrants Installation	10	06NOV10	15NOV10	122	0
Building Information Systems						
Electrical						
004940	Cable Tray Installation	30	18DEC10	17JAN11	9	0
004950	Cable Conduit Installation	30	03JAN11	01FEB11	9	0
004960	Cat6 Cable Installation	25	23JAN11	16FEB11	9	0
004970	Rack Cabinets & Patch Panels Installation	25	12FEB11	08MAR11	9	0
004980	Outlets Installation	12	09MAR11	20MAR11	9	0
004990	Labeling and Testing	5	21MAR11	25MAR11	9	0
Inspections, Punchlist						
005000	Punch List (Clin 0005)	7	21MAR11	27MAR11	9	0
Buildings						
UOQ Building						
Foundations						
Basement						
000605	(O.Q)Relocation of Utilities	15	10NOV09	24NOV09	0	0
000610	[O.Q]Foundation Excavation	15	25NOV09	13DEC09	0	0
000620	[O.Q]Stabilized filling	7	14DEC09	20DEC09	0	0
000740	[O.Q]Foundation Rebar Works	20	21DEC09	12JAN10	0	0
000750	[O.Q]Foundation FormWork	7	26DEC09	02JAN10	8	0
000760	[O.Q]Foundation Concrete Works	1	13JAN10	13JAN10	0	0
000770	[O.Q]Foundation Insulation Works	7	15MAY10	21MAY10	3	0
000630	[O.Q]Earthfilling	5	22MAY10	26MAY10	29	0
Superstructure						
Basement						
000780	[O.Q]Basement Floor Columns Rebar Works	20	16JAN10	07FEB10	0	0
000810	[O.Q]Basement Floor Shear+Ext Walls Cons.Rebar W	20	16JAN10	07FEB10	0	0
000790	[O.Q]Basement Floor Columns FormWork	18	21JAN10	10FEB10	0	0
000820	[O.Q]Basement Floor Shear+Ext Walls Cons.FormWor	18	21JAN10	10FEB10	0	0
000800	[O.Q]Basement Floor Columns Concrete Works	15	27JAN10	11FEB10	0	0
000830	[O.Q]Basement Floor Shear+Ext Walls Cons.Concret	15	27JAN10	11FEB10	0	0



SAMPLE

Start Date	21AUG09
Finish Date	03MAY11
Data Date	01SEP09
Run Date	14NOV10 14:16

Early Bar
Progress Bar
Critical Activity

SPL1

XYZ Company

W917PM-09-C-0999
Sample Project for Section 01321

Baseline Schedule

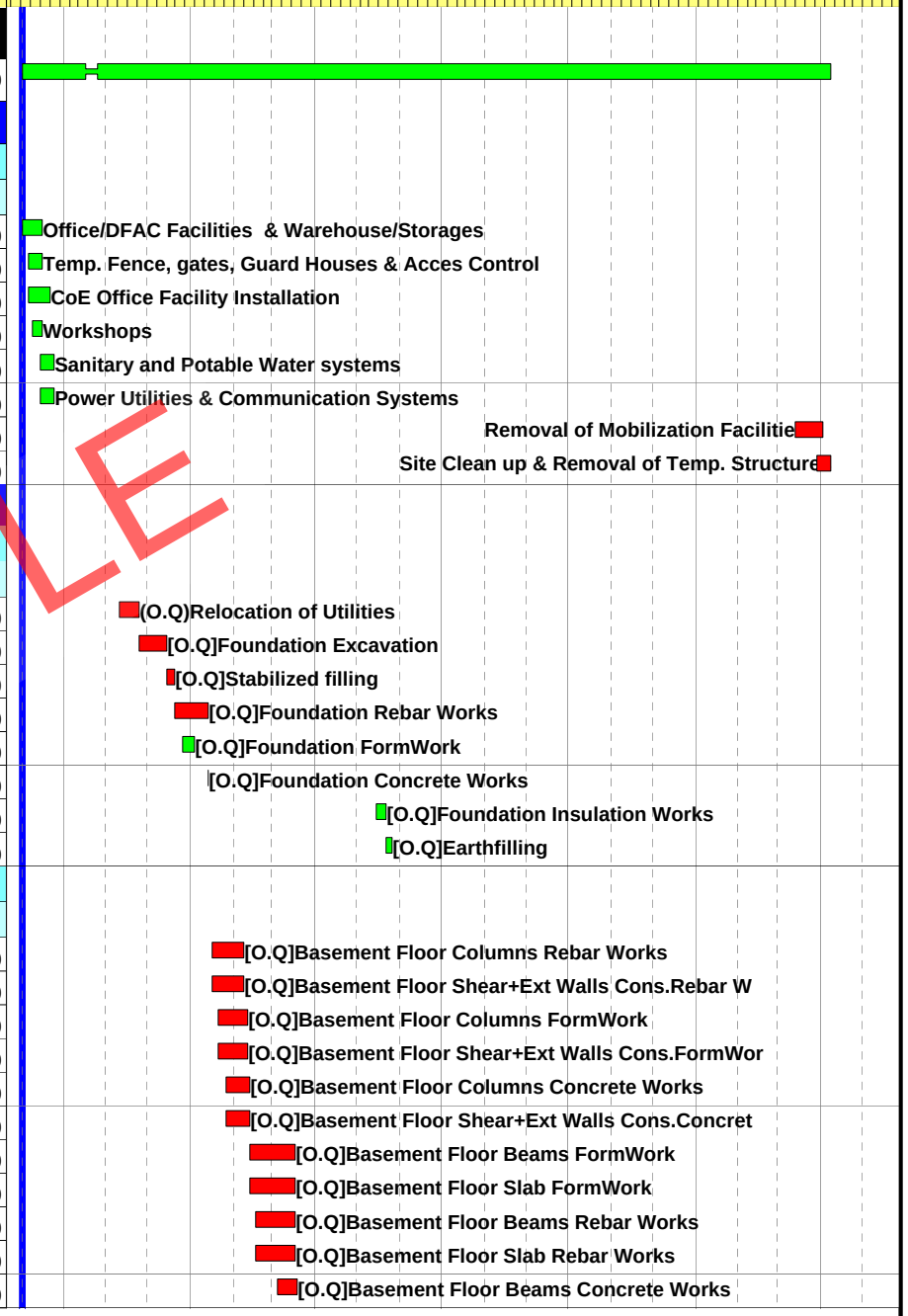
Date	Revision	Checked	Approved

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

W917PM-09-C-0999

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
Total		584	01SEP09	07APR11	26	0
Mob/Demob						
000230	Office/DFAC Facilities & Warehouse/Storages	15	01SEP09	15SEP09	14	0
000240	Temp. Fence, gates, Guard Houses & Acces Control	10	06SEP09	15SEP09	9	0
000250	CoE Office Facility Installation	15	06SEP09	20SEP09	9	0
000270	Workshops	7	09SEP09	15SEP09	17	0
000255	Sanitary and Potable Water systems	10	14SEP09	23SEP09	9	0
000260	Power Utilities & Communication Systems	10	14SEP09	23SEP09	9	0
000280	Removal of Mobilization Facilities	20	14MAR11	02APR11	0	0
000290	Site Clean up & Removal of Temp. Structures	10	29MAR11	07APR11	0	0
Unaccompanied Officers Quarters (O.Q.)						
Foundations						
Basement						
000605	(O.Q)Relocation of Utilities	15	10NOV09	24NOV09	0	0
000610	[O.Q]Foundation Excavation	15	25NOV09	13DEC09	0	0
000620	[O.Q]Stabilized filling	7	14DEC09	20DEC09	0	0
000740	[O.Q]Foundation Rebar Works	20	21DEC09	12JAN10	0	0
000750	[O.Q]Foundation FormWork	7	26DEC09	02JAN10	8	0
000760	[O.Q]Foundation Concrete Works	1	13JAN10	13JAN10	0	0
000770	[O.Q]Foundation Insulation Works	7	15MAY10	21MAY10	3	0
000630	[O.Q]Earthfilling	5	22MAY10	26MAY10	29	0
Superstructure						
Basement						
000780	[O.Q]Basement Floor Columns Rebar Works	20	16JAN10	07FEB10	0	0
000810	[O.Q]Basement Floor Shear+Ext Walls Cons.Rebar W	20	16JAN10	07FEB10	0	0
000790	[O.Q]Basement Floor Columns FormWork	18	21JAN10	10FEB10	0	0
000820	[O.Q]Basement Floor Shear+Ext Walls Cons.FormWor	18	21JAN10	10FEB10	0	0
000800	[O.Q]Basement Floor Columns Concrete Works	15	27JAN10	11FEB10	0	0
000830	[O.Q]Basement Floor Shear+Ext Walls Cons.Concret	15	27JAN10	11FEB10	0	0
000840	[O.Q]Basement Floor Beams FormWork	30	12FEB10	16MAR10	0	0
000870	[O.Q]Basement Floor Slab FormWork	30	12FEB10	16MAR10	0	0
000850	[O.Q]Basement Floor Beams Rebar Works	26	17FEB10	17MAR10	0	0
000880	[O.Q]Basement Floor Slab Rebar Works	26	17FEB10	17MAR10	0	0
000860	[O.Q]Basement Floor Beams Concrete Works	15	04MAR10	18MAR10	0	0



SAMPLE

Start Date	21AUG09
Finish Date	03MAY11
Data Date	01SEP09
Run Date	14NOV10 14:27

Early Bar
Progress Bar
Critical Activity

SPL1

XYZ Company

W917PM-09-C-0999
Sample Project for Section 01321

Cost Report by CLIN

Sheet 1 of 23

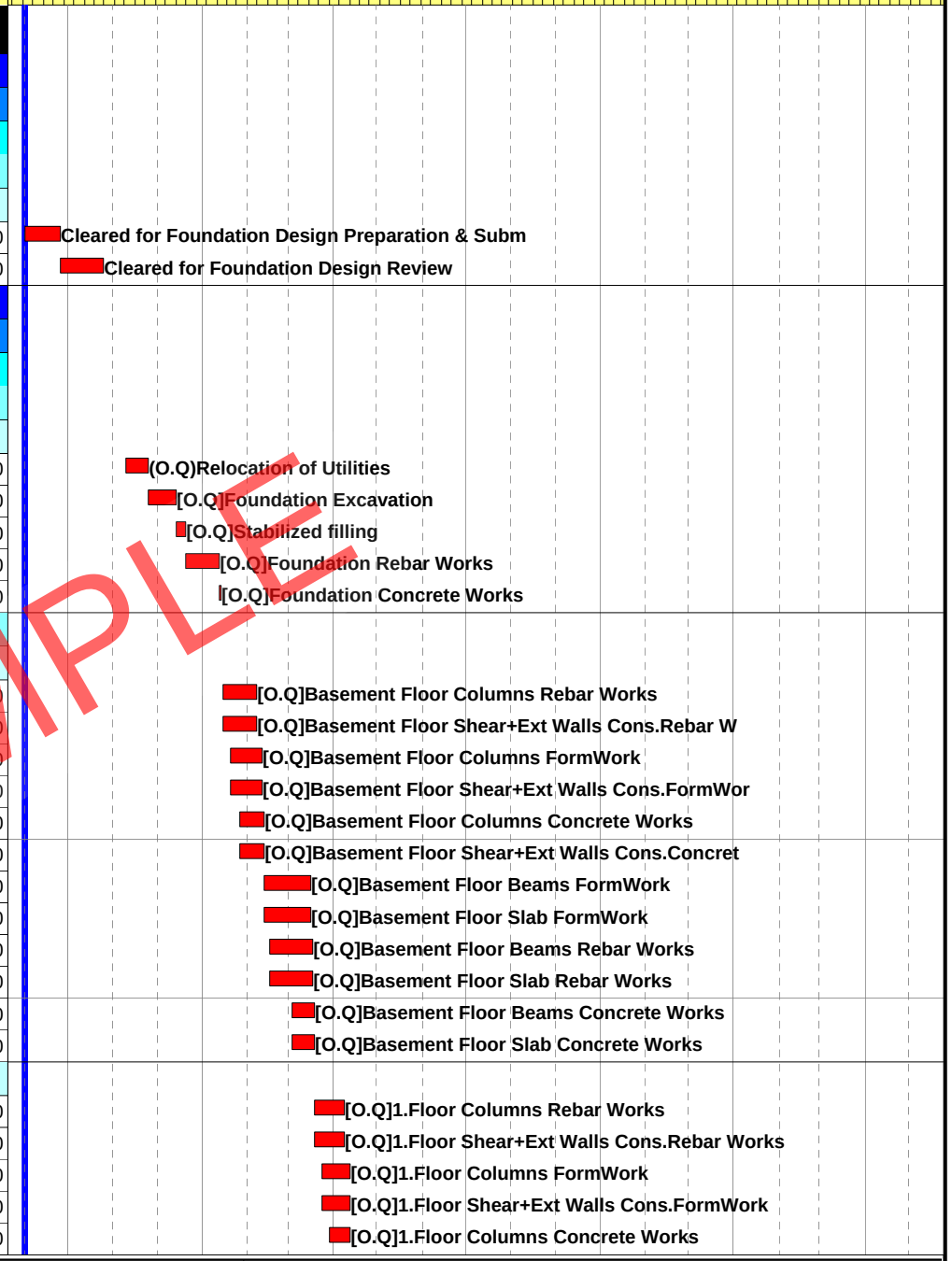
Date	Revision	Checked	Approved

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

W917PM-09-C-0999

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float
Design					
000430	Cleared for Foundation Design Preparation & Subm	25	01SEP09	25SEP09	0
000440	Cleared for Foundation Design Review	30	26SEP09	25OCT09	0
Construction					
Buildings					
UOQ Building					
Foundations					
Basement					
000605	(O.Q)Relocation of Utilities	15	10NOV09	24NOV09	0
000610	[O.Q]Foundation Excavation	15	25NOV09	13DEC09	0
000620	[O.Q]Stabilized filling	7	14DEC09	20DEC09	0
000740	[O.Q]Foundation Rebar Works	20	21DEC09	12JAN10	0
000760	[O.Q]Foundation Concrete Works	1	13JAN10	13JAN10	0
Superstructure					
Basement					
000780	[O.Q]Basement Floor Columns Rebar Works	20	16JAN10	07FEB10	0
000810	[O.Q]Basement Floor Shear+Ext Walls Cons.Rebar W	20	16JAN10	07FEB10	0
000790	[O.Q]Basement Floor Columns FormWork	18	21JAN10	10FEB10	0
000820	[O.Q]Basement Floor Shear+Ext Walls Cons.FormWor	18	21JAN10	10FEB10	0
000800	[O.Q]Basement Floor Columns Concrete Works	15	27JAN10	11FEB10	0
000830	[O.Q]Basement Floor Shear+Ext Walls Cons.Concret	15	27JAN10	11FEB10	0
000840	[O.Q]Basement Floor Beams FormWork	30	12FEB10	16MAR10	0
000870	[O.Q]Basement Floor Slab FormWork	30	12FEB10	16MAR10	0
000850	[O.Q]Basement Floor Beams Rebar Works	26	17FEB10	17MAR10	0
000880	[O.Q]Basement Floor Slab Rebar Works	26	17FEB10	17MAR10	0
000860	[O.Q]Basement Floor Beams Concrete Works	15	04MAR10	18MAR10	0
000890	[O.Q]Basement Floor Slab Concrete Works	15	04MAR10	18MAR10	0
1st Floor					
000900	[O.Q]1.Floor Columns Rebar Works	20	19MAR10	08APR10	0
000930	[O.Q]1.Floor Shear+Ext Walls Cons.Rebar Works	20	19MAR10	08APR10	0
000910	[O.Q]1.Floor Columns FormWork	18	25MAR10	11APR10	0
000940	[O.Q]1.Floor Shear+Ext Walls Cons.FormWork	18	25MAR10	11APR10	0
000920	[O.Q]1.Floor Columns Concrete Works	15	29MAR10	12APR10	0



SAMPLE

Start Date	21AUG09
Finish Date	03MAY11
Data Date	01SEP09
Run Date	14NOV10 14:44

Early Bar
Progress Bar
Critical Activity

SPL1

XYZ Company

W917PM-09-C-0999
Sample Project for Section 01321

Critical Path

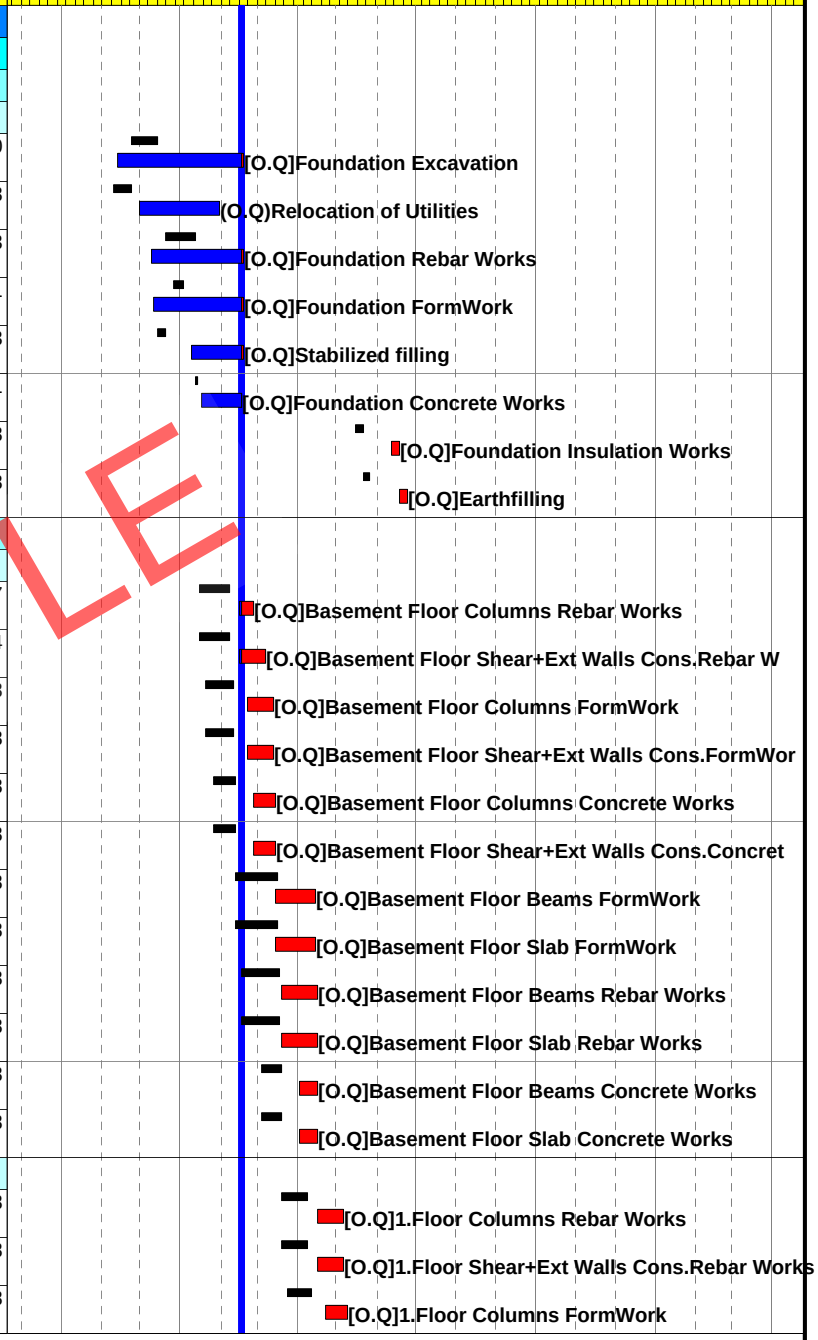
Sheet 1 of 6

Date	Revision	Checked	Approved

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	Early Start	Early Finish	Total Float	BL Var Start	BL Var Finish
Buildings									
UOQ Building									
Foundations									
Basement									
000610	[O.Q]Foundation Excavation	15	1	90	14NOV09A	17FEB10	-39	11	-60
000605	(O.Q)Relocation of Utilities	15	0	100	30NOV09A	30JAN10A		-16	-58
000740	[O.Q]Foundation Rebar Works	20	1	60	10DEC09A	17FEB10	-39	11	-33
000750	[O.Q]Foundation FormWork	7	1	60	12DEC09A	17FEB10	-31	14	-41
000620	[O.Q]Stabilized filling	7	1	75	10JAN10A	17FEB10	-39	-25	-53
000760	[O.Q]Foundation Concrete Works	1	0	50	17JAN10A	16FEB10	-31	-4	-31
000770	[O.Q]Foundation Insulation Works	7	7	0	12JUN10	18JUN10	-36	-28	-28
000630	[O.Q]Earthfilling	5	5	0	19JUN10	23JUN10	-10	-28	-28
Superstructure									
Basement									
000780	[O.Q]Basement Floor Columns Rebar Works	20	8	30	16FEB10A	25FEB10	-39	-28	-17
000810	[O.Q]Basement Floor Shear+Ext Walls Cons.Rebar W	20	15	30	16FEB10A	06MAR10	-39	-28	-24
000790	[O.Q]Basement Floor Columns FormWork	18	18	0	22FEB10	13MAR10	-39	-28	-28
000820	[O.Q]Basement Floor Shear+Ext Walls Cons.FormWor	18	18	0	22FEB10	13MAR10	-39	-28	-28
000800	[O.Q]Basement Floor Columns Concrete Works	15	15	0	26FEB10	14MAR10	-39	-28	-28
000830	[O.Q]Basement Floor Shear+Ext Walls Cons.Concret	15	15	0	26FEB10	14MAR10	-39	-28	-28
000840	[O.Q]Basement Floor Beams FormWork	30	30	0	15MAR10	14APR10	-39	-28	-28
000870	[O.Q]Basement Floor Slab FormWork	30	30	0	15MAR10	14APR10	-39	-28	-28
000850	[O.Q]Basement Floor Beams Rebar Works	26	26	0	20MAR10	15APR10	-39	-28	-28
000880	[O.Q]Basement Floor Slab Rebar Works	26	26	0	20MAR10	15APR10	-39	-28	-28
000860	[O.Q]Basement Floor Beams Concrete Works	15	15	0	02APR10	16APR10	-39	-28	-28
000890	[O.Q]Basement Floor Slab Concrete Works	15	15	0	02APR10	16APR10	-39	-28	-28
1st Floor									
000900	[O.Q]1.Floor Columns Rebar Works	20	20	0	17APR10	06MAY10	-39	-28	-28
000930	[O.Q]1.Floor Shear+Ext Walls Cons.Rebar Works	20	20	0	17APR10	06MAY10	-39	-28	-28
000910	[O.Q]1.Floor Columns FormWork	18	18	0	22APR10	09MAY10	-39	-28	-28



SAMPLE

Start Date	21AUG09
Finish Date	01JUN11
Data Date	17FEB10
Run Date	14NOV10 17:24

Target
Early Bar
Progress Bar
Critical Activity

SPL2

XYZ Company

W917PM-C-09-C-0999

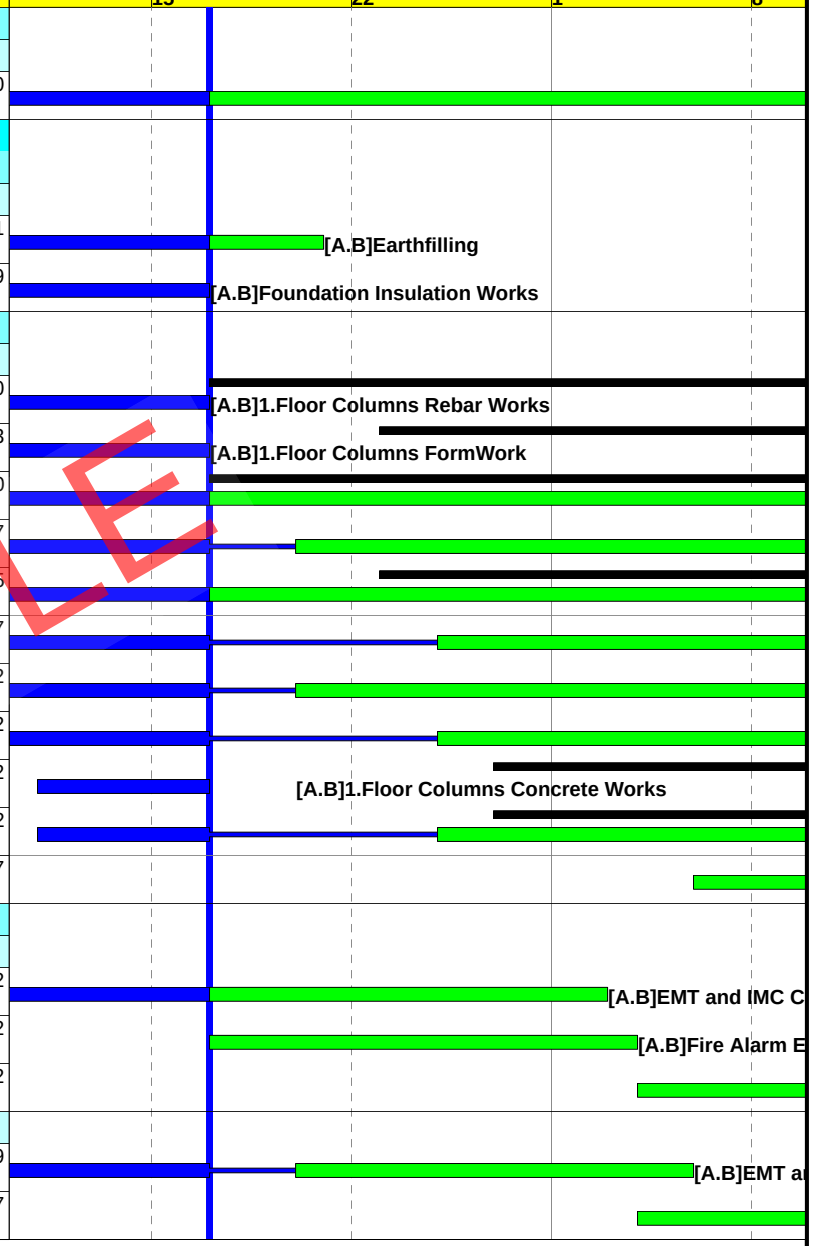
Project Schedule

Date	Revision	Checked	Approved

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	Early Start	Early Finish	Total Float	BL Var Start	BL Var Finish
002350	[O.Q]Plumbing Works	315*	303*	0	05FEB10A	18DEC10	44	152	-100
Admin-SS Building									
Foundations									
Basement									
002730	[A.B]Earthfilling	5	3	75	13JAN10A	20FEB10	50	91	61
002870	[A.B]Foundation Insulation Works	5	0	75	18JAN10A	16FEB10	50	81	59
Superstructure									
1st Floor									
003000	[A.B]1.Floor Columns Rebar Works	20	0	60	26JAN10A	16FEB10	15	21	20
003010	[A.B]1.Floor Columns FormWork	18	0	60	28JAN10A	16FEB10	21	24	23
003030	[A.B]1.Floor Shear+Ext Walls Cons.Rebar Works	20	20	60	29JAN10A	11MAR10	15	18	0
003070	[A.B]1.Floor Beams Rebar Works	26	26	35	30JAN10A	19MAR10	24	46	27
003040	[A.B]1.Floor Shear+Ext Walls Cons.FormWork	18	18	60	31JAN10A	09MAR10	18	21	5
003090	[A.B]1.Floor Slab FormWork	30	30	40	01FEB10A	29MAR10	15	39	17
003060	[A.B]1.Floor Beams FormWork	30	30	30	03FEB10A	24MAR10	20	37	22
003100	[A.B]1.Floor Slab Rebar Works	26	26	30	10FEB10A	25MAR10	19	36	22
003020	[A.B]1.Floor Columns Concrete Works	15	0	60	11FEB10A	19FEB10	20	15	22
003050	[A.B]1.Floor Shear+Ext Walls Cons.Concrete Works	15	15	30	11FEB10A	13MAR10	15	15	2
003080	[A.B]1.Floor Beams Concrete Works	15	15	0	06MAR10	20MAR10	24	27	27
Electrical									
Basement									
004045	[A.B]EMT and IMC Conduits Base Fl.	14	14	30	15JAN10A	02MAR10	215	165	132
004145	[A.B]Fire Alarm EMT and IMC Conduits Base Fl.	15	15	0	17FEB10	03MAR10	215	132	132
004165	[A.B]Fire Alarm Cable Base Fl.	8	8	0	04MAR10	11MAR10	229	132	132
1st Floor									
004050	[A.B]EMT and IMC Conduits 1.Fl.	14	14	30	01FEB10A	05MAR10	227	199	179
004150	[A.B]Fire Alarm EMT and IMC Conduits 1.Fl.	15	15	0	04MAR10	18MAR10	215	168	167



SAMPLE

Start Date	21AUG09
Finish Date	01JUN11
Data Date	17FEB10
Run Date	14NOV10 17:23

Target
Early Bar
Progress Bar
Critical Activity

SPL2

Sheet 2A of 3B

XYZ Company

W917PM-C-09-C-0999

3-Week Lookahead

Date	Revision	Checked	Approved

© Primavera Systems, Inc.

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description	Budgeted Cost	% Comp	Earned value cost (BCWP)
SPL2 W917PM-C-09-C-0999				
+ 0001 Mobilization/Demobilization				
		0	0	0
+ 0002 Design Costs				
		0	0	0
+ 0003 Unaccompanied Officer's Quarters				
		0	0	0
+ 0004 Administrative Support Facilities				
		0	0	0
+ 0005 Building Information Systems				
		0	0	0
+ 0006 Electrical Distribution Systems				
		0	0	0
+ 0007 Water Distribution System				
		0	0	0
+ 0008 Sewer Collection System				
		0	0	0
+ 0009 Storm Drainage System				
		0	0	0
+ 0010 Site Improvements and Demolition				
		0	0	0
+ 0011 Information Distribution Systems				
		0	0	0
+ 0012 Dining Facility-OPTION				
		0	0	0
+ 0013 Vehicle Maintenance Shop Facility-OPTION				
		0	0	0
+ 0014 Paving and Side Walks-OPTION				
		0	0	0
+ 0015 Power Generation Facility				
		0	0	0

SAMPLE

Start Date	21AUG09
Finish Date	01JUN11
Data Date	17FEB10
Run Date	14NOV10 17:21

© Primavera Systems, Inc.

SPL2 XYZ Company Sheet 1 of 1

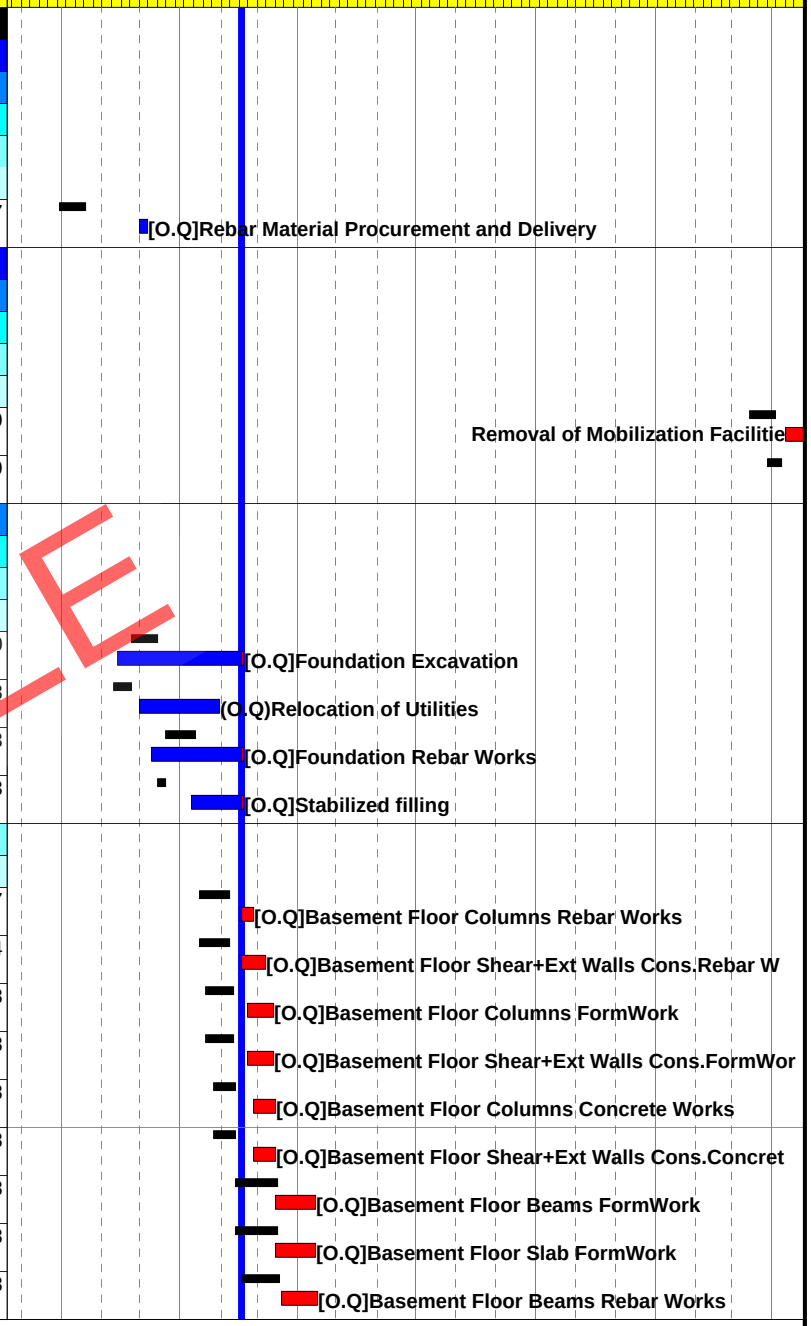
W917PM-C-09-C-0999
Sample Project for 01321

Earned Value Report

Date	Revision	Checked	Approved

Up Provincial Response Company
Maydan Shahr Wardak

Activity ID	Activity Description	Orig Dur	Rem Dur	% Comp	Early Start	Early Finish	Total Float	BL Var Start	BL Var Finish
W917PM-C-09-C-0999									
Procurement									
Buildings									
UOQ Building									
000725	[O.Q]Rebar Material Procurement and Delivery	20	0	100	01DEC09A	05DEC09A		-62	-47
Construction									
Mob/Demob									
Demobilization									
000280	Removal of Mobilization Facilities	20	20	0	12APR11	01MAY11	-39	-29	-29
000290	Site Clean up & Removal of Temp. Structures	10	10	0	27APR11	06MAY11	-39	-29	-29
Buildings									
UOQ Building									
Foundations									
Basement									
000610	[O.Q]Foundation Excavation	15	1	90	14NOV09A	17FEB10	-39	11	-60
000605	(O.Q)Relocation of Utilities	15	0	100	30NOV09A	30JAN10A		-16	-58
000740	[O.Q]Foundation Rebar Works	20	1	60	10DEC09A	17FEB10	-39	11	-33
000620	[O.Q]Stabilized filling	7	1	75	10JAN10A	17FEB10	-39	-25	-53
Superstructure									
Basement									
000780	[O.Q]Basement Floor Columns Rebar Works	20	8	30	16FEB10A	25FEB10	-39	-28	-17
000810	[O.Q]Basement Floor Shear+Ext Walls Cons.Rebar W	20	15	30	16FEB10A	06MAR10	-39	-28	-24
000790	[O.Q]Basement Floor Columns FormWork	18	18	0	22FEB10	13MAR10	-39	-28	-28
000820	[O.Q]Basement Floor Shear+Ext Walls Cons.FormWor	18	18	0	22FEB10	13MAR10	-39	-28	-28
000800	[O.Q]Basement Floor Columns Concrete Works	15	15	0	26FEB10	14MAR10	-39	-28	-28
000830	[O.Q]Basement Floor Shear+Ext Walls Cons.Concret	15	15	0	26FEB10	14MAR10	-39	-28	-28
000840	[O.Q]Basement Floor Beams FormWork	30	30	0	15MAR10	14APR10	-39	-28	-28
000870	[O.Q]Basement Floor Slab FormWork	30	30	0	15MAR10	14APR10	-39	-28	-28
000850	[O.Q]Basement Floor Beams Rebar Works	26	26	0	20MAR10	15APR10	-39	-28	-28



SAMPLE

Start Date	21AUG09
Finish Date	01JUN11
Data Date	17FEB10
Run Date	14NOV10 17:18

Target
Early Bar
Progress Bar
Critical Activity

SPL2

XYZ Company

W917PM-C-09-C-0999
Sample Project for Section 01321

Critical Path

Sheet 1 of 4

Date	Revision	Checked	Approved

© Primavera Systems, Inc.

CEMP-CE Regulation No. 1-1-11	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1-1-11 15 Jun 95
	Administration PROGRESS, SCHEDULES, AND NETWORK ANALYSIS SYSTEMS	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314-1000

ER 1-1-11

CEMP-CE
CECW-OC

Regulation
ER 1-1-11

15 June 1995

Administration

PROGRESS, SCHEDULES, AND NETWORK ANALYSIS SYSTEMS

1. Purpose. This regulation states the policy on the use of any of the various schedule management methods. The basic regulation provides general policy relative to the use of the various systems (bar charts, network analysis etc.) as well as administration of contract provisions. If this ER conflicts with the Federal Acquisition Regulations or any of its supplements, they shall govern over the ER.

2. Applicability. This regulation is applicable to all USACE commands.

3. References.

a. FAR 52.236-15.

b. DOD FAR Supplement 236.273

c. EP 415-1-4

d. CEGS 01310

4. Policy. Obtaining quality construction on time and within budget is a primary goal of the U.S. Army Corps of Engineers. In order to manage the time specified for the accomplishment of a project, a schedule is required on construction contracts by references 3.a. & 3.b. The contractor is responsible for scheduling the work and progress so that the contract completion date is met. The Administrative Contracting Officers (ACO) monitors the contractor's schedule to assure compliance. If a schedule is not provided, the Contracting Officer may withold progress payments per paragraph (a) of reference 3.a. If actual progress fails to meet the schedule, the Contracting Officer shall take appropriate actions to assure compliance with the progress of the work. Therefore, the schedule is vital to effective construction management by the contractor and the Government. Reference 3.d. allows the District Technical Staff to choose the type of contract schedule during the design phase. Bar charts can be used to manage simple jobs. When by its nature a construction project or other effort is complex with many interrelated activities, a network schedule may be the most effective tool for analyzing progress, projecting completion, and

---

This regulation supersedes ER 1-1-11, dated 15 March 1990.

calculating payment commensurate with actual progress. The determination of applicability of network scheduling is the responsibility of the Contracting Officer. When determined to be applicable, network schedules must be carefully specified, updated regularly, and used effectively. Standard data exchange format shall be used to monitor a contractor's schedule when the contractor and the Government operate on different programs.

5. Description of the System. A network schedule requires first a logic diagram graphically depicting the sequence and interdependence of the work. It can be drawn in either the precedence or arrow diagram format, but it must accurately represent the intended work sequence and indicate actual constraints. Details of diagramming techniques are contained in Reference 3.c. Network Analysis System Guide. Once the logic diagram is made, an analysis is required which calculates early and late start and finish dates for the activities as well as the spare time or float available to accomplish the activity. Resource data such as cost and responsibility may be entered for activities also. Once calculated, these results can be ordered in different arrangements or sorts and compiled into specific reports for management purposes. Actual progress must be entered once work commences. Based on this progress, revised start and finish dates, and progress payment can be calculated.

6. Use of the System.

a. Network Analysis System (NAS), being a management control tool, may be applied to many aspects of the work by the Corps of Engineers. It can be employed profitably in the management of in-house operations such as engineering and design, and life cycle project management. A comprehensive life cycle analysis of a major civil works project should include, but not be limited to, activities for preparation of design memos and environmental impact statements, real estate planning and acquisition, preparation of plans and specifications, reservoir clearing, advertising and/or negotiation for construction, relocation and recreation contracts. Annual funding forecasts can be derived from early and late finish sorts of the analysis if costs have been assigned to each activity. Analysis can be used to set construction time prior to advertisement or select alternative contracting methods when user requirements preclude the use of sealed bidding.

b. Construction schedules after contract award should be contractor prepared in order to involve the contractor in the actual planning. Updates of actual progress should also have contractor participation as well as Government concurrence since

the resultant analysis will project early or late contract accomplishment and progress payment due. Changes to the work and occurrences which impact progress must be entered in the schedule logic in order to keep the schedule up to date, to reflect actual job progress, to determine where the contractor must accelerate to regain the schedule when behind due to his/her own actions, and to determine the impact and effect of Government actions on the contractor in order to provide equitable adjustments to the contract time as required.

7. Contract Administration.

a. When the Contracting Officer has determined that NAS will be specified for use on a construction contract, the provision of the specifications must be carefully edited for the specific job. Reference 3.d. CEGS 01310, contains numerous notes indicating where such editing can be done. This editing is not only permissible, but is also mandatory.

b. The contractor should submit his/her NAS within the time required by the specifications. The schedule must be verified as being logical and the completion dates attainable. Failure to enforce this requirement is highly detrimental to project management. Partial payments cannot be processed until an acceptable NAS schedule has been submitted. The Contracting Officer may not allow work to start nor make partial payments until an acceptable schedule (interim or final) is received and approved. Once approved, the schedule must be maintained up to date with regard to job progress and changes. Failure to maintain job progress is fatal to effective schedule management.

c. Reference 3.d. is a guide specification for a contractor prepared NAS. This provision serves as an example of the authorization of reference 3b. Specific contract requirements will dictate how this provision is edited.

d. Appendix A contains the Standard Data Exchange Format specification. This format should be specified and used to transfer contract schedule data between different contractor and Government NAS programs.

8. Implementation. NAS can be a valuable tool in both Corps life cycle project management and contract administration. NAS schedule data can be used to project contract completion, schedule Government actions, incorporate changes and occurrences during execution of the contract, analyze their effect on the contract completion, and arrive at equitable adjustments. The following actions should be implemented to assure effective management by use of NAS where it is selected and specified:

a. Assure that appropriate Government personnel at all levels are adequately trained in the use of NAS. Basic training is available through the HQUSACE Construction Training Program.

b. Carefully edit CEGS 01310 to fit job requirements. When necessary, transfer of data should be accomplished by inclusion of a technical provision for standard data exchange format when the contractor and the Government use different programs. The Government should not dictate a proprietary system.

c. After receipt, promptly and carefully review the submission of the NAS. A conference type review with the contractor is effective. Verify the schedule logic, contract conformance, and approve or disapprove the schedule promptly.

d. Enforce all contract clauses and provisions for submission, updating, reporting, and payments, and insist upon the ACO's approval of all input data prior to updating. Failure to maintain an accurately updated schedule will undermine all attempts to manage the schedule properly.

e. Include submittals, approvals, etc in the schedule.

f. At the time notice-to-proceed is given for a change order, promptly incorporate the logic changes in the network. Analysis of the effect of changes on the schedule will provide the basis for equitable time extensions of the contract.

g. When work is delayed by causes beyond the contractor's control, the contractor is obligated to notify the ACO within 10 days of the beginning of the delay. The ACO is then obligated to ascertain the facts, establish the extent of the delay, and extend the contract time when justified. These determinations can be made only if the schedule is accurately updated.

h. Avoid specifying proprietary computer programs. Contractors should be encouraged to prepare their own analysis in lieu of hiring consultants to plan and update their schedules.

FOR THE COMMANDER:

James D. Craig

1 Appendix
APP A - Standard Data Exchange Format specification

JAMES D. CRAIG
Colonel, Corps of Engineers
Chief of Staff

STANDARD DATA EXCHANGE FORMAT SPECIFICATION

PART 1- GENERAL

1. Application of This Provision: The Standard Data Exchange Format (SDEF) provides a non-proprietary protocol to exchange project planning and progress data between scheduling systems.

2. File Type and Format: The data file shall consist of a 132 character, freed format, "ASCII" file. Text shall be left-justified and numbers shall be right-justified in each field. Data records must conform, exactly, to the sequence, column position, maximum length, mandatory values, and field definitions described below to comply with the SDEF. Unless specifically stated, all numbers shall be whole numbers. Fields containing numbers shall not be zero filled. All data columns shall be separated by a single blank column. The file shall not contain blank lines.

3. Usage Notes: Where appropriate, notes regarding proper usage of systems to support the SDEF have been included in brackets ([ ]). These notes are included to assist users in creating SDEF-compatible files, given the variety of software systems that support the SDEF.

4. Recommended Systems: Several systems have been tested to determine the accuracy of importing and exporting SDEF files. For information on the current list of recommended systems, please contact Mr. Stan Green at HQUSACE, (202) 761-0206. Although the currently listed system have been tested other systems may also be acceptable provided those systems correctly import and export SDEF files.

5. SDEF Checker Program: A program that checks whether a file meets the SDEF is available free of charge. A copy of this program may be obtained by written request to: U.S. Army Corps of Engineers, ATTN: Mr. Bill East (CECER-FFA), P.O. Box 9005, Champaign, IL 61826-90005. A description of the SDEF Checker is also available on the Internet and CivilNet.

PART 2- SDEF SPECIFICATION

6. SDEF Organization: The SDEF shall consist of the following records provided in the exact sequence shown below:

ER 1-1-11
15 Jun 95

Paragraph Reference	Record Description	Remarks
6.a	Volume Record	Mandatory First Line of File
6.b	Project Record	Mandatory Second Line of File
6.c	Calendar Record(s)	Mandatory One Record Minimum
6.d	Holiday Record(s)	Mandatory if Holidays Used
6.e	Activity Record(s)	Mandatory Records
6.f	Precedence Record(s)	Mandatory for Precedence
6.g	Unit Cost Record(s)	Mandatory for Unit Costs
6.h	Progress Record(s)	Mandatory Records
6.i	File End Record	Mandatory Last Line of Disk/File

6.a. Volume Record: The Volume Record shall be used to control the transfer of data that may not fit on a single disk. The first line in every file used to store SDEF data shall be the Volume Record. The Volume Record shall sequentially identify the number of the data transfer disk(s). The Volume Record shall have the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	VOLM	Fixed	Filled
DISK NUMBER	6 - 7	2	√	Number	Right Justified

6.a.(l) The RECORD IDENTIFIER is the first four characters of this record. The required value for this field shall be "VOLM". The VOLM record must appear on the first line of the SDEF data file.

6.a.(2) The DISK NUMBER field shall identify the number of the data disk used to store the data exchange information. If all data may be contained on a single disk, this field shall contain the value of "l". If more disks are required, then the second disk shall contain the value "2", the third disk shall be designated with a "3", and so on. Identifcation of the last data disk is accomplished in the Reject End Record.

6.b. Project Record: The Project Identifier Record shall contain general project information. Because more than one SDEF file may be required for data transfer between large projects, the PROJ record shall be the second line of the first SDEF file transferred. The PROJ record shall contain information in the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1- 4	4	PROJ	Fixed	Filled
DATA DATE	6- 12	7	√	ddmmmyy	Filled
PROJECT IDENTIFIER	14-17	4	√	Alpha.	Left Justified
PROJECT NAME	19-66	48	√	Alpha.	Left Justified
CONTRACTOR NAME	68-103	36	√	Alpha.	Left Justified
ARROW OR PRECEDENCE	105-105	1	A,P	Fixed	Filled
CONTRACT NUMBER	107-112	6	√	Alpha.	Left Justified
PROJECT START	114-120	7	√	ddmmmyy	Filled
PROJECT END	122-128	7	√	ddmmmyy	Filled

6.b.(1) The RECORD IDENTIFIER is the first four characters of this record. The required value for this field shall be "PROJ". This record shall contain the general project information and indicates which scheduling method shall be used.

6.b.(2) The DATA DATE is the date of the schedule calculation. The abbreviation "ddmmmyy" refers to a date format that shall translate a date into two numbers for the day, three letters for the month, and two numbers for the year. For example, March 1, 1999 shall be translated into OlMar99. This same convention for date formats shall be used throughout the entire data format. To ensure that dates are translated consistently, the following abbreviations shall be used for the three character month code:

Abbreviation	Month
JAN	January
FEB	February
MAR	March
APR	April
MAY	May
JUN	June
JUL	July
AUG	August
SEP	September
OCT	October
NOV	November
DEC	December

6.b.(3) The PROJECT IDENTIFIER is a maximum four character abbreviation for the schedule. These four characters shall be used to uniquely identify the project and specific update as agreed upon by Contractor and Contracting Officer. When utilizing scheduling software these four characters shall be used to select the project. Software manufacturers shall provide information to users to ensure that data importing programs do not automatically overwrite other schedules with the same PROJECT IDENTIFIER.

6.b.(4) The PROJECT NAME field shall contain the name and location of the project edited to fit the space provided. The data appearing here shall appear on scheduling software reports. The abbreviation "Alpha." refers to an "Alphanumeric" field value and shall be used throughout the remainder of this specification.

6.b.(5) The CONTRACTOR NAME field shall contain the Construction Contractor's name, edited to fit the space provided.

6.b.(6) The ARROW OR PRECEDENCE field shall indicate which method shall be used for calculation of the schedule. The value "A" shall signify the Arrow Diagramming Method. The value "P" shall signify the Precedence Diagramming Method. The ACTIVITY ID field of the Activity Record shall be interpreted differently depending on the value of this field. The Precedence Record shall be required if the value of this field is "P". [Usage note: software systems may not support both arrow and precedence diagramming. It is recommended that the selection of the type of network be based on the capabilities of the software used by project partners.]

6.b.(7) The CONTRACT NUMBER field shall contain the contract number for the project. For example, the construction contract number DACA85-89-C-0001 shall be entered into this field as "890001".

6.b.(8) The PROJECT START field shall contain the date that the Contractor acknowledges the Notice to Proceed (NTP). [Usage note: Software systems may use a project start date to constrain the first activity of a network. To ensure consistent scheduling calculations across products, it is recommended that the first activity in the schedule contain an EARLY START constraint and a software system's PROJECT START date only be used to report on the project's start date.]

6.b.(9) The PROJECT END field shall contain the date that the Contractor plans to complete the work as approved by the Contracting Officer. [Usage note: software systems may use a project end date to constrain the last activity of a network. To ensure consistent scheduling calculations across products, it is recommended that the last activity in the schedule contain an EARLY START constraint and a software system's PROJECT END date only be used to report on the project's end date.]

6.c. Calendar Record: The Calendar Record(s) shall follow the Project Identifier Record in the first disk of data transferred. A minimum of one Calendar Record shall be required for all data exchange activity files. The format for the Calendar Record shall be as follows:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	CLDR	Fixed	Filled
CALENDAR CODE	6 - 6	1	√	Alpha.	Filled
WORKDAYS	8 - 14	7	SMTWTFS	Fixed	Filled
CALENDAR DESCRIPTION	16-45	30	√	Alpha.	Left Justified

6.c.(1) The RECORD IDENTIFIER shall always begin with "CLDR" to identify it as a Calendar Record. Each Calendar Record used shall have this identification in the first four columns. [Usage note: Systems contain a variety of calendar options. It is recommended that the least common denominator of calendar features between the systems be used as the basis for creating the SDEF file for a given project.]

6.c.(2) The CALENDAR CODE shall be used in the activity records to signify that this calendar is associated with the activity. [Usage note: Some systems do not allow for alphanumeric CALENDAR CODES, but only allow positive integers from 1 to 9. It is recommended that only positive integers be used for the CALENDAR CODE field to support the widest variety of scheduling systems.]

6.c.(3) The WORKDAYS field shall contain the work-week pattern selected with "Y", for Yes, and "N", for No. The first character shall be Sunday and the last character Saturday. An example of a typical five (5) day work-week would be NYYYYYN. A seven (7) day work-week would be YYYYYYY.

6.c.(4) The CALENDAR DESCRIPTION shall be used to briefly describe the calendar used.

6.d. Holiday Record: The Holiday Record(s) shall follow the Calendar Record(s) in the first disk of data transferred. There may be calendars without any holidays designated or several Holiday Records for each Calendar Record(s). The format for the Holiday Record shall be as follows:

ER 1-1-11
15 Jun 95

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	HOLI	Fixed	Filled
CALENDAR CODE	6 - 6	1	√	Alpha.	Filled
HOLIDAY DATE	8 - 14	7	√	ddmmmyy	Filled
HOLIDAY DATE	16-22	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	24-30	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	32-38	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	40-46	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	48-54	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	56-62	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	64-70	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	72-78	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	80-86	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	88-94	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	96-102	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	104-110	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	112-118	7	-	ddmmmyy	May be Filled
HOLIDAY DATE	120-126	7	-	ddmmmyy	May be Filled

6.d.(1) The RECORD IDENTIFIER shall always begin with "HOLI". Each Holiday Record used shall have this identification in the first four columns.

6.d.(2) The CALENDAR CODE indicates which work-week calendar the holidays shall be applied to. More than one HOLI record may be used for a given CALENDAR CODE.

6.d.(3) The HOLIDAY DATE shall contain the date of each individual non-work day.

6.e. Activity Records: Activity Records shall follow any Holiday Record(s). If there are no Holiday Record(s), then the Activity Records shall follow the Calendar Record(s). There shall be one Activity Record for every activity in the network. Each activity shall have one record in the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	ACTV	Fixed	Filled
ACTIVITY ID	6 - 15	10	√	Integer	See Comment Below
ACTIVITY DESCR.	17-46	30	√	Alpha.	Left Justified
ACTIVITY DURATION	48-50	3	√	Integer	Right Justified
CONSTRAINT DATE	52-58	7		ddmmmyy	May be Filled
CONSTRAINT TYPE	60-61	2		ES or LF	May be Filled
CALENDAR CODE	63-63	1	√	Alpha.	Filled
HAMMOCK CODE	65-65	1	Y, blank	Fixed	May be Filled
WORKERS PER DAY	67-69	3		Integer	Right Justified
RESPONSIBILITY CODE	71-74	4		Alpha.	Left Justified
WORK AREA CODE	76-79	4		Alpha.	Left Justified
MOD OR CLAIM NO.	81-86	6		Alpha.	Left Justified
BID ITEM	88-93	6		Alpha.	Left Justified
PHASE OF WORK	95-96	2		Alpha.	Left Justified
CATEGORY OF WORK	98-98	1		Alpha.	May be Filled
FEATURE OF WORK	100-128	30		Alpha.	Left Justified

6.e.(1) The RECORD IDENTIFIER for each activity description record must begin with the four character "ACTV" code. This field shall be used for both the Arrow Diagram Method (ADM) and Precedence Diagram Method (PDM),

6.e.(2) The ACTIVITY ID consists of coding that shall differ, depending on whether the ADM or PDM method was selected in the Project Record. If the ADM method was selected then the field shall be interpreted as two right-justified fields of five (5) integers each. If the PDM method was selected the field shall be interpreted as one (1) right-justified field of ten (10) integers each. The maximum activity number allowed under this arrangement is 99999 for ADM and 9999999999 for the PDM method. [Usage note: Many systems allow alphanumeric ACTIVITY IDs. While the SDEF does not strictly, allow the use of alphanumeric values, users may agree to use the ACTIVITY ID field to exchange alphanumeric data. It is recommended that the ACTIVITY ID be restricted to integers when one or more of the systems being used for scheduling allows only integer ACTIVITY ID values.]

6.e.(3) The ACTIVITY DESCRIPTION shall be a maximum of 30 characters. Descriptions must be limited to the space provided.

6.e.(4) The ACTIVITY DURATION contains the estimated original duration for the activity on the schedule. The duration shall be based upon the work-week designated by the activity's related calendar.

6.e.(5) The CONSTRAINT DATE field shall be used to identify a date that the scheduling system may use to modify float calculations. If there is a date in this field, then there must be a valid entry in the CONSTRAINT TYPE field.

6.e.(6) The CONSTRAINT TYPE field shall be used to identify the way that the scheduling system shall use the CONSTRAINT DATE to modify schedule float calculations. If there is a value in this field, then there must be a valid entry in the CONSTRAINT DATE field. The valid values for the CONSTRAINT TYPE are as follows:

Code	Definition
ES	The CONSTRAINT DATE shall replace an activity's early start date, if the early start date is prior to the CONSTRAINT DATE.
LF	The CONSTRAINT DATE shall replace an activity's late finish date, if the late finish date is after the CONSTRAINT DATE.

[Usage note: Systems provide a wide variety of constraint types that may not be supported by other systems. It is recommended that constraint types be restricted to the values above regardless of the capabilities of the various systems being used for scheduling.]

6.e.(7) The CALENDAR CODE relates this activity to an appropriate work-week calendar. The ACTIVITY DURATION must be based on the valid work-week referenced by this CALENDAR CODE field.

6.e.(8) The HAMMOCK CODE indicates that a particular activity does not have its own independent duration, but takes its start dates from the start date of the preceding activity (or node) and takes its finish dates from the finish dates of its succeeding activity (or node). If the value of the HAMMOCK CODE field is "Y", then the activity is a hammmock activity.

6.e.(9) The WORKERS PER DAY shall contain the average number of workers expected to work on the activity each day the activity is in progress. If this code is required by project scheduling specifications, values for this data will be right justified. Activities without workers per day shall have a value of "0".

6.e.(10) The RESPONSIBILITY CODE shall identify the subcontractors or major trade involved with completing the work for the activity. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(11) The WORK AREA CODE shall identify the location of the activity within the project. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(12) The MOD OR CLAIM NUMBER shall uniquely identify activities that are added or changed on a construction contract modification, or activities that justify any claimed time extensions. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(13) The BID ITEM shall identify the bid item number associated with each activity. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(14) The PHASE OF WORK shall identify the timing of a specific activity within the entire project. If this code is required by project scheduling specifications, value for this data will be left justified.

6.e.(15) The CATEGORY OF WORK shall identify the general type of work performed by every activity. If this code is required by project scheduling specifications, value for this data will be placed in the field.

6.e.(16) The FEATURE OF WORK shall identify a very broad designation of the general type of work that is being accomplished by the activity. If this code is required by project scheduling specifications, value for this data will be left justified. [Usage note: Many systems require that FEATURE OF WORK values be placed in several activity code fields. It is recommended that users review SDEF documentation to determine the correct way to use a given software system to produce the FEATURE OF WORK code.]

6.f. Precedence Record: The Precedence Record(s) shall follow the Activity Records if a Precedence Diagram Method schedule (PDM) is identified in the ARROW OR PRECEDENCE field of the Project Record. The Precedence Record has the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	PRED	Fixed	Filled
ACTIVITY ID	6-15	10	√	Integer	See Comment Below
PRECEDING ACTIVITY	17 -26	10	√	Integer	See Comment Below
PREDECESSOR TYPE	28-28	1	√	S, F, C	Filled
LAG DURATION	30-33	4	√	Integer	Right Justified

6.f.(1) The RECORD IDENTIFIER shall begin with the four characters "PRED" in the first four columns of the record.

6.f.(2) The ACTIVITY ID identifies the activity whose predecessor shall be specified in this record.

6.f.(3) The PRECEDING ACTIVITY number is the number of an activity that precedes the activity noted in the ACTIVITY ID field.

6.f.(4) The PREDECESSOR TYPE field indicates the type of relation that exists between the chosen pair of activities. Valid PREDECESSOR TYPE fields areas follows:

Code	Definition
S	Start-to-Start relation
F	Finish-to-Finish relation
C	Finish-to-Start relation

[Usage note: Some systems provide additional predecessor types that may not be supported by all other systems. It is recommended that predecessor types be restricted to the values above regardless of the capabilities of the various systems being used for scheduling.]

6.f.(5) The LAG DURATION field contains the number of days delay between the preceding and current activity. [Usage note: Some systems allow negative values for the LAG DURATION. Because these values are not supported by all other systems, it is recommended that values be restricted to zero and positive integers.]

6.g. Unit Cost Record: The Unit Cost Record shall follow all Precedence Records. If the schedule utilizes the Arrow Diagram Method, then the Unit Cost Record shall follow any Activity records. There shall be one Unit Cost Record for every activity that is not a lump sum activity. [Usage note: (1) It is recommended that users who wish to exchange unit cost data contact SDEF vendor representatives to determine the ability of the software system to import/export unit cost information. (2) If the software being used by each member of the project team supports unit cost data then users may wish to conduct a trial run of the SDEF data exchange with a two or three-activity network to ensure that unit cost data transfers as expected. If problems are found please consult vendor representatives for resolution prior to exchange of full project schedules. (3) Unit cost record data does not, in most systems, result in the correct values being placed in the ACTIVITY COST and COST TO DATE fields of the Progress (PROG) Record. Users must, at this time, manually transfer the data from the Unit Cost Record to the Progress Record.

The fields for this record shall take the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1 - 4	4	UNIT	Fixed	Filled
ACTIVITY ID	6-15	10	√	Integer	See Comment Below
TOTAL QTY	17-29	13	√	Format 8.4	Right Justified
COST PER UNIT	31-43	13	√	Format 8.4	Right Justified
QTY TO DATE	45-57	13	√	Format 8.4	Right Justified
UNIT OF MEASURE	59-61	3	√	Alpha.	Left Justified

6.g.(1) The RECORD IDENTIFIER shall be identified with the four characters 'UNIT" placed in the first four columns of the record.

6.g.(2) The ACTIVITY ID for each activity shall match the format described in the activity record. Each activity may have only one Unit Cost Record.

6.g.(3) The TOTAL QTY is the total amount of material to be used in this activity. This number consists of eight digits, one decimal point and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 25-29. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(4) The COST PER UNIT is the cost, in dollars and cents, for each unit to be used in this activity. This number consists of eight digits, one decimal point, and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 39-43. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(5) The QTY TO DATE is the quantity of material installed in this activity up to the data date. This number consists of eight digits, one decimal point, and four more digits. An example of a number in this format is "11111111.1111". If decimal places are not needed this field shall still contain a ".0000" in columns 53-57. [Usage note: Many systems support a different format for this value that does not include as many decimal places. It is recommended that users determine their requirements for significant digits based on the lowest common denominator of the software systems being used for a given project.]

6.g.(6) The UNIT OF MEASURE is an abbreviation that may be used to describe the units being measured for this activity. Valid values for this field are any meaningful English or metric unit, except "LS" for Lump Sum. Lump Sum activities are not to have Unit Cost Records.

6.h. Progress Record: Progress Record(s) shall follow all Unit Cost Record(s). If there are no Unit Cost Record(s), then the Progress Record(s) shall follow all Precedence Records. If the schedule utilizes the Arrow Diagram Method, then the Progress Record shall follow any Activity Records. One Progress Record is required for every activity in the Activity Record. The fields for this Record shall be provided in the following format:

ER1-1-11
15 Jun 95

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1-4	4	PROG	Fixed	Filled
ACTIVITY ID	6-5	10	√	Integer	See Comment Below
ACTUAL START DATE	17-23	7	√	ddmmmyy	Filled if Started
ACTUAL FINISH DATE	25-31	7	√	ddmmmyy	Filled if Finished
REMAINING DURATION	33-35	3	√	Integer	Right Justified
ACTIVITY COST	37-48	12	√	Format 9.2	Right Justified
COST TO DATE	50-61	12	√	Format 9.2	Right Justitied
STORED MATERIAL	63-74	12	√	Format 9.2	Right Justified
EARLY START DATE	76-82	7	√	ddmmmyy	Filled if Not Started
EARLY FINISH DATE	84-90	7	√	ddmmmyy	Filled if Not Finished
LATE START DATE	92-98	7	√	ddmmmyy	Filled if Not Started
LATE FINISH DATE	100-1067		√	ddmmmyy	Filled if Not Finished
FLOAT SIGN	108-1081		+, -	Fixed	Filled if Not Finished
TOTAL FLOAT	110-1123		√	Integer	R. Just. if Not Finished

6.h.(1) The RECORD IDENTIFIER shall begin with the four characters "PROG" in the first four columns of the record.

6.h.(2) The ACTIVITY ID for each activity for which progress has been posted shall match the format described in the Activity Record.

6.h.(3) An ACTUAL START DATE is required for alI in-progress activities. The ACTUAL START DATE shall be the same as, or later than, the PROJECT START date contained in the Project Record. The ACTUAL START DATE shall also be the same as, or prior to, the DATA DATE contained in the Project Record. If there is an ACTUAL START DATE for an activity that there must also be a REMAINING DURATION, and the values for the EARLY START DATE and LATE START DATE are blank. [Usage note: Some systems allow default values for ACTUAL START DATE if the date is not entered by the user. Because the failure to include a start date for activities may result in different schedule calculations, it is recommended that the ACTUAL START DATE be required for all activities in progress.]

6.h.(4) An ACTUAL FINISH DATE is required for all completed activities. If the REMAINING DURATION of an activity is zero, then there must be an ACTUAL FINISH DATE. If there is an ACTUAL FINISH DATE, then values for the EARLY START DATE, LATE START DATE, EARLY FINISH DATE, LATE FINISH DATE, FLOAT SIGN, and TOTAL FLOAT shall be blank. [Usage note: Some systems allow default values for ACTUAL FINISH DATE if the date is not entered by the user. Because the failure to include a finish date for activities may result in different schedule calculations, it is recommended that the ACTUAL FINISH DATE be required for all activities in progress.]

6.h.(5)AREMAININ G DURATION is required for all activities. Activities that have not started shall have a remaining duration equal to their original duration. Activities completed based on time, shall have a zero (0) REMAINING DURATION. [Usage note: Systems have a variety of "short-cut" methods to determine the REMAINING DURATION value. It is recommended that users actually consider the time required to complete the remaining work on a given task, rather than allow a system to calculate the remaining duration based on the amount of work that has already been accomplished.]

6.h.(6) The ACTIVITY COST contains the estimated earned value of the work to be accomplished in the activity. An example of a number in this format is "1111111 11.11". If decimal places are not needed this field shall still contain a ".00" in the last three columns of this field. [Usage note: Users should inquire of software vendors if the user needs to add a zero in the data field to produce the default value "0.00".]

6.h.(7) The COST TO DATE contains the earned value for the activity. If there is an ACTUAL START DATE, then there must also be some value for COST TO DATE. An example of a number in this format is "111111111.11". If decimal places are not needed, this field shall still contain a ".00" in the last three columns of this field. The COST TO DATE is not tied to REMAINING DURATION. For example, if the REMAINING DURATION is "0", the COST TO DATE may only be 95% of the ACTIVITY COST. This difference may be used to reflect 5% retainage for punch list items. [Usage note: Systems implement cost information in different ways. It is recommended that users carefully review SDEF documentation and test results to determine how to ensure that SDEF data is exported correctly.]

6.h.(8) The STORED MATERIAL field contains the value of the material that the Contractor has paid for and is on site or in secure storage areas that is a portion of the COST TO DATE. An example of a number in this format is "111111111.11". If decimal places are not needed, this field shall still contain a ".00" in the last three columns of this field. [Usage note: Systems implement the stored materials field in a variety of ways. Many systems do not enforce STORED MATERIAL + COST TO DATE < ACTIVITY COST. To avoid potential confusion between systems, it is recommended that new activities be added to a schedule to reflect the cost of large equipment procurement rather than use the STORED MATERIALS field.]

6.h.(9) The EARLY START DATE indicates the earliest date possible that an activity can start as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL START DATE, then this field shall be blank.

6.h.(10) The EARLY FINISH DATE indicates the earliest date possible that an activity can finish as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank.

6.h.(11) The LATE START DATE indicates the latest date that an activity can begin as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL START DATE, then this field shall be blank.

6.h.(12) The LATE FINISH DATE indicates the latest date that an activity can finish as calculated by a CPM scheduling system or other Contracting Officer approved planning method. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank.

6.h.(13) The FLOAT SIGN indicates whether the float time calculated using a CPM scheduling system or other Contracting Officer approved planning method, is positive or negative in nature. If the progress record for an activity contains an ACTUAL FINISH DATE, then this field shall be blank. In the case of zero float this field shall be blank.

6.h.(14) The TOTAL FLOAT indicates the total float time. In the Precedence Diagram Method (PDM), the total float is the difference between the early and late start or finish dates. In the Arrow Diagram Method (ADM), the total float is equal to the late event time at the end of the activity, minus the sum of the early event time at the start of the activity plus the duration of the activity.

6.i. Project End Record: The Project End Record shall be used to identify that the data file is completed. If the ASCII End of File character is encountered, then data import programs shall use that character to infer that the data continues on the next disk. The user shall then be prompted for the next disk number, based on the VOLM record data. The Project End Record shall be the last record of the entire data file, and shall have the following format:

Description	Column Position	Max. Len.	Req. Value	Type	Notes
RECORD IDENTIFIER	1-3	3	END	Fixed	Filled

6.i.(1) The RECORD IDENTIFIER for the Project End Record shall be "END". Data contained in the data exchange file that occurs after this record shall not be used.

SDEF Activity Codes

Code	Max Length	Description	Remarks
WRKP	3	Workers per day	Number
RESP	4	Responsibility	GOVT = AED, PRIM = Prime Contractor, any 4 characters for subcontractors
AREA	4	Area	WBS Level 2
MODF	6	MOD or Claim #	
BIDI	6	Bid Item	CLIN or sub-CLIN to conform with cost breakdown in Contract Section 00010
PHAS	2	Phase	WBS Level 1
CATW	1	Category of work	
FOW	30	Feature of work	FOW1 & FOW2 & FOW3 in Primavera P3
USER DEFINED (total of 8 characters are available in P3):			
LVL3	2	WBS Level 3	Mandatory
LVL4	1	WBS Level 4	Mandatory.
			End of mandatory activity codes
LVL5	1	WBS Level 5	
CLIN	2	CLIN	May be used to summarize costs by CLIN if BIDI is sub-CLINs. Last 2 characters of CLIN.

NOTES:

Schedules must be organized with a WBS created in the activity code dictionary, not the software WBS. Generally, four levels are sufficient for effective schedule organization. Additional codes may be created if required.

WBS Level	Activity Code
1	PHAS
2	AREA
3	LVL3
4	LVL4

Standard Activity Codes - WBS

PHAS	AREA	LVL3	LVL4	LVL5
01 Milestones				
	0101 Contract Milestones			
	0102 Project Milestones			
02 Pre-construction				
	0201 Pre-construction Meetings			
	0202 Pre-construction Submittals			
	0203 DBA Insurance			
03 Design				
	0301 10% Design Submittal			
	0302 35% Design Submittal			
	0303 65% Design Submittal			
	0304 99% Design Submittal			
	0305 100% Design Submittal			
04 Procurement				
	0401 Civil/Structural			
	0402 Architectural			
	0403 Electrical			
	0404 Mechanical			
	0405 Plumbing			
05 Construction				
	0501 Mob/Demob			
		01 Mobilizaton		
		02 Demobilizaton		
	0502 Sitework			
		03 Site Preparation		
		04 Site Drainage System		
		05 Force Protection		
			1 Perimeter Wall	
			2 ECP #1	
			3 ECP #2	
			4 Guardshack #1	
			5 Guardshack #2	
			6 Guard Tower # 1	
			7 Guard Tower # 2	
			8 Guard Tower # 3	
			9 Guard Tower # 4	
			A Guard Tower # 5	
	0503 Utilities			
		0A Water		
			B Water Treatment	
			C Water Distribution	
		0B Sewer		
			D Sewage Collection	
			E Sewage Treatment	
		0C Power		
			F Power Generation	
				A Generator #1
				B Generator #2
			G Power Distribution	
	0504 Buildings	0D Building 1		
			H Foundations	0 Basement
			I Superstructure & Close-in	1 1st Floor
			J Architectural - Exterior	2 2nd Floor
			K Architectural - Interior	3 3rd Floor
			L Electrical	4 Roof
			M Mechanical	
			N Plumbing	
			O Fire Protection System	
			P Communications	
			Q Inspections, Punchlists	
	0505 Other Construction			
06 Contract Close-out				
	0601 Close-out Inspections			
	0602 As-Built Drawings			
	0603 O&M Manuals & Training			
	0604 Demobilization			

NOTE:
Activity codes in bold italic are required codes. All other codes are suitable for a typical building project but may be changed to suit the scope of work.

SECTION 01335

SUBMITTAL PROCEDURES FOR SITE ADAPT PROJECTS

1.0 GENERAL

1.1 REFERENCE

The publication listed below forms a part of this specification to the extent referenced. The publication is referenced to in the text by basic designation only.

NATIONAL INSTITUTE OF BUILDING SCIENCES (NIBS)

Unified Master Reference List (UMRL)

National Institute of Building Sciences
1090 Vermont Avenue, NW, Suite 700
Washington, DC 20005-4905
Email: nibs@nibs.org
FAX: (202) 289-1092
Tele: (202) 289-7800

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows.

1.2.1 DESIGN SUBMITTALS

Contractor furnished design submittals are the various design documents which primarily consist of field investigations, calculations, design analysis, drawings and specifications.

In addition, for each design submittal, the contractor shall submit all non-administrative modifications issued for the contract as part of the Design Submittal package to enable AED to validate that these modifications have been incorporated into this design submittal.

Design submittals should only address Contract requirements not shown on plans and any specifications already furnished to the Contractor as part of this contract. Plans and specifications furnished to the Contractor shall NOT be included as part of any Design Submittal. The Contractor shall complete all work as shown in these furnished drawings without deviation, unless site conditions mandate changes (larger building foundations per geotechnical investigations, etc.).

The Contractor shall clearly label and date all design submittals to reflect the current design stage and date of submission to the Government to avoid confusion between current and previous submittals. The Contractor shall not begin construction work until the Government has reviewed and approved the work presented in each Design Submittal, including complete resolution of all DrChecks comments, and the Contracting Officer has cleared work for construction. Clearance for construction shall not be construed as meaning Government approval. Unless otherwise indicated, the risk for the design is the sole responsibility of the Contractor.

The sole responsibility of ensuring that the design submittals comply with contract documents remains with the Contractor, in accordance with this section of the contract. The Government retains the right to comment on the design at any design stage, and the lack of Government comments at a given review cannot be used as a basis for the Contractor to fail to address the Government's comments on subsequent reviews, regardless of design stage. Furthermore, approval of incomplete designs will not relieve the Contractor of the responsibility for any error which may exist, and which may require rework or

other appropriate adjustment to the contract terms, as determined at the sole discretion of the Government. It is the sole responsibility of the Design-Build or Site Adapt Contractor to ensure that submittals do or do not comply with the contract documents. Government review, clearance for construction, or approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract. Government review, clearance for construction, or approval of post design construction submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory.

As a minimum, design submittals shall be submitted at the following intervals:

Preliminary design reports – 10%

Site-Adapt General Design review - 65%

Final Site-Adapt Design review - 90%

Cleared For Construction review - 100%

1.2.1.1 PRELIMINARY DESIGN REPORTS – (10%)

The review of this submittal is primarily to ensure that the Contractor has at a minimum developed the test well and completed the sub-surface investigation. **This work shall be completed not more than 60 days following Notice To Proceed (NTP). Failure to do so at the satisfaction of the Government shall constitute grounds for withholding of all progress payments.**

a. Geotechnical Report, indicating appropriate information for various site characteristics, soil parameters as determined by certified lab tests, allowable soil bearing capacities, correlation with foundation design parameters, and any changes in foundation design of structures furnished in the Contract; estimated settlement for building foundation loads; and all other project feature changes due to the Geotechnical Report conclusions.

b. Percolation test locations and results, and complete leachfield design (if required by Section 01010 of the SOW), which indicate the site will accommodate such a system for the given project requirements, and alternatives proposed if, and only if, the site characteristics will not support such a system.

1.2.1.2 SITE-ADAPT GENERAL DESIGN (65%)

This Design Submittal presents all information necessary to “Site Adapt” the fully designed and detailed buildings and other project features. It is crucial that the submittal is complete and includes all components noted below and any other pertinent information not listed which the Contractor requires to enable construction to begin as soon as possible. As a minimum, for each Contract project location the submittal shall contain:

a. Results of the site topographic survey which shall include highlighting of significant features (wadis, adjacent properties and structures, roads, etc.) to provide a detailed, overall understanding of the project site and surrounding area; demolition plan for existing site features; complete grading and drainage plan with existing grades, proposed grades, and building finished floor elevations based on Contract technical requirements; Geotechnical Report;

b. Any necessary adaptations of the Concept Plan and detailed design drawings furnished with this Contract that might be required due to actual site constraints, to include: water supply/storage location and distribution layout plan; wastewater collection or treatment location and tie-in to all required buildings; electrical generation and distribution plan; connection of existing roads with ECP location(s); and any other changes required due to adjacent property or existing topography. As noted in Paragraph 1.2.1, this would also include proposed changes to the detailed drawings if, and only if, site conditions mandate revisions.

c. Septic Tank drawings and details (if required by Section 01010 of the SOW or not provided as part of this contract), showing tank depth and sizing based on expected sanitary load, and all connecting piping, with dimensions.

d. Complete design analysis, plans and specifications for any contract feature(s) not already provided in the Contract that the Contractor would like Partial Clearance for Construction on once the Design Submittal has been approved, including project components with long ordering, fabrication and delivery times.

e. Outline of Construction Specification Sections to be used for other work yet to be submitted at the 90% Final Site-Adapt Design Review submittal, and those Specification items requiring Government Approval (GA), unless 100% Technical Specifications were provided with the Contract.

f. Preliminary drawing and details of any grease interceptors and oil-water separators required. Grease interceptors should either be gravity or hydro-mechanical types. Drawings would show sizing, depth, and all connecting piping. Design analysis shall include calculations for sizing both the interceptor/separator and connecting piping.

g. Preliminary cross sections of roads and sidewalks, showing all essential dimensions, materials, layers, and proposed fore and back slopes of adjacent drainage features.

h. All preliminary sketches of site storm drainage structures, including calculations in the design analysis for sizing and sloping of pipe runs and ditches. Provide cross sections of drainage structures such as ditches and culverts.

1.2.1.3 FINAL SITE-ADAPT DESIGN REVIEW (90%):

The review of this submittal is primarily to insure that the contract documents and design analysis are proceeding in a timely manner and that the Contract requirements and design criteria are being correctly understood and adhered to. The submittal shall consist of the following:

a. Design Analysis complete (including Geotechnical Report).

b. Draft Construction Specifications complete - all anticipated sections, edited to include only applicable requirements, if not provided as part of the Contract.

c. Construction Drawings complete with all 65% comments incorporated. The Contractor is expected to have completed all of his coordination checks and have the drawings in a design complete condition. The drawings shall be finalized at this time including the incorporation of any design review comments generated by all past design reviews. The drawings shall contain all the details necessary to assure a clear understanding of the work throughout construction.

1.2.1.4 “CLEARED FOR CONSTRUCTION” SUBMITTAL (100%):

The review of this submittal is to insure that the design is in accordance with directions provided the Contractor during the design process. The only effort remaining between the Final Site-Adapt Design Review Submittal and the "Cleared For Construction" Design Review Submittal is the incorporation of all Government review comments. The Contractor shall submit the following documents for this review:

a. Design Analysis, only if changes have occurred since 90% Design Submittal. The Design Analysis shall contain all explanatory material giving the design rationale for any design decisions which would not be obvious to an engineer reviewing the Final Drawings and Specifications.

b. Geotechnical Report, complete.

c. Construction Specifications, complete.

d. Construction Drawings, complete.

Once the design documents have been "Cleared for Construction" by the Contracting Officer, the Contractor shall clearly identify each document by annotating it as "Cleared for Construction."

1.2.2 PARTIAL DESIGN SUBMITTALS

In the interest of expediting construction, the Contracting Officer may approve partial design submittals, procurement of materials and equipment, as well as issue the Notice To Proceed (NTP) for construction of those elements of the design which have been cleared for construction. Such partial notices to proceed shall be solely at the discretion of the Contracting Officer. The Contractor must obtain the approval of the Designer of Record (DOR) and the Government's concurrence for any Contractor proposed revision to the professionally stamped and sealed design reviewed and Cleared for Construction by the Government, before proceeding with the revision. The Government reserves the right to non-concur with any revision to the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and cleared for construction design. Any revision to the design, which deviates from the contract requirements (i.e., the RFP and the accepted proposal), will require a modification, pursuant to the Changes clause, in addition to Government concurrence. The Government reserves the right to disapprove such a revision. Unless the Government initiates a change to the contract requirements, or the Government determines that the Government furnished design criteria are incorrect and must be revised, any Contractor initiated proposed change to the contract requirements, which results in additional cost, shall strictly be at the Contractor's expense. The Contractor shall track all approved revisions to the reviewed and cleared for construction design and shall incorporate them into the As-Built design documentation, in accordance with Section 01780A, CLOSEOUT SUBMITTALS, Paragraphs 1.1 and 1.2, which lists all requirements associated with submission of editable CAD format As-Builts required as part of this contract. The Designer of Record shall document its professional concurrence on the As-Builts for any revisions by affixing its stamp and seal on the drawings and specifications.

1.2.3 DEVIATIONS AND CHANGES TO THE STANDARD DESIGNS

Contractor shall construct standard building designs as indicated. Any request to deviate or change the standard building designs must be due to changed site conditions ONLY TO and submitted to the AED Resident Office administering the contract. Contractor shall indicate the changes and provide a narrative justification for the changes proposed, but shall not proceed with deviations without written approval.

1.2.4 USE OF DRCHECKS$_{SM}$ FOR DESIGN SUBMITTAL COMMENT AND RESPONSE

1.2.4.1 DRCHECKS$_{SM}$ WEB LINK

All AED Design Submittal review comments will be documented using the standard design review tool for the U.S. Army Corps of Engineers, a web-based application called "DrChecks$_{SM}$". The web link to DrChecks$_{SM}$ is:

https://www.projnet.org/projnet/binKornHome/index.cfm

1.2.4.2 DRCHECKS$_{SM}$ VENDOR IDENTIFICATION AND TUTORIAL

Upon notification of award, the contractor shall immediately coordinate with the Chief, Engineering Branch, AED to acquire a vendor identification and a brief tutorial on the use of DrChecks$_{SM}$. The

contractor is responsible for providing their own DrChecks$_{SM}$ Administrator within their own design staff personnel to access and accomplish actions within DrChecks$_{SM}$.

1.2.4.3 NOTIFICATION OF DRCHECKS$_{SM}$ FILE ACCESS

The Afghanistan Engineer District will complete a review at every Design Submittal stage for conformance with the technical requirements of the Contract and document all comments in DrChecks$_{SM}$. At completion of the review, a notification will be issued to the Contractor by the Contracting Officer's representative that the particular DrChecks$_{SM}$ file will be opened to the Contractor. Until this time, the Contractor is not able to view any AED comments for that particular Design Submittal.

1.2.4.4 FURTHER CONTRACTOR INFORMATION AFTER DRCHECKS$_{SM}$ REVIEWS

See Paragraph 3.7.4, Government Review, for further procedures and requirements associated with Design Submittal reviews.

1.2.5 CONSTRUCTION SUBMITTALS

1.2.5.1 CONTRACTOR FURNISHED GOVERNMENT APPROVED CONSTRUCTION SUBMITTALS (GA)

Government approved construction submittals are primarily related to plans (Contractor Quality Control, Accident Prevention, Resident Management System, Area Use, etc.), schedules (Project Schedule/Network Analysis), and certificates of compliance, reports and records/statements. They may also include proposed variations to approved design documents in accordance with the paragraph entitled "VARIATIONS".

In addition, GA construction submittals are required for the following:

a. CIVIL FEATURES

TESTING RESULTS: Data will include information on the locations and depths of all viable water supply sources at the site(s) involved and a water quantity and water quality analysis for each source from the Ministry of Public Health or other certified testing firm.

b. MECHANICAL FEATURES

EQUIPMENT SUBMITTALS: Manufacturer's standard catalog data, installation, Operation and Maintenance (O&M) manuals and construction details for water wells, water tanks, control valves, pipe insulation, water pumps, air handling units, condensers, variable air volume (VAV) boxes.

TESTING RESULTS: For water tanks, water pumps (including instrumentation), water piping, sprinkler systems, and oxygen systems, submit six (6) copies of each test containing the following information in bound letter-size booklets:

1) The date the tests were performed.

2) A list of equipment used, with calibration certifications.

3) A copy of measurements taken.

4) The parameters to be verified.

5) The condition specified for the parameter.

6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance the plans and specifications.

7) A description of adjustments performed.

Individual reports shall be provided for storage tank tests, piping tests, system performance tests, high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible.

c. ELECTRICAL FEATURES

PRODUCT DATA and SHOP DRAWINGS: generators (and its auxiliaries), load bank, transformers, substations, panels/switchboards/motor control centers, lightning protection, receptacles, circuit breakers.

DESIGN DATA: lightning protection and grounding.

TEST DATA: Lightning protection and grounding.

d. ARCHITECTURAL FEATURES

PRODUCT DATA/CATALOGUE CUTS/SHOP DRAWINGS/SCHEDULES: Specialty doors and frames (fire rated, sound rated, bullet resistant, security, overhead rolling); door hardware; windows; metal roofing (including fasteners, flashing, and accessories); building insulation; fire-rated and water-resistant gypsum board; and other specialty products (bullet resistant glazing/panels).

COLOR BOARD: Architectural finishes

PRODUCT DATA/CATALOGUE CUTS/INSTALLATION INSTRUCTIONS: Exterior Insulation and Finish System (EIFS)

SHOP DRAWINGS: Casework/Cabinetry

1.2.5.2 FOR INFORMATION ONLY CONSTRUCTION SUBMITTALS (FIO)

All submittals not requiring Designer of Record or Government approval will be for information only. These construction submittals shall be checked, stamped, signed and dated by the Contractor's Quality Control Engineer, certifying that such submittal complies with the contract requirements. All Contractor submittals shall be subject to review by the Government at any time during the course of the contract. Any Contractor submittal found to contain errors or omissions shall be resubmitted as one requiring "approval". No adjustment for time or money will be allowed for corrections required as a result of noncompliance with plans or specifications. Normally submittals For Information Only will not be returned. Approval of the Contracting Officer is not required on FIO submittals. These submittals will be used for information purposes. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications and will not prevent the Contracting Officer from requiring removal and replacement if nonconforming material is incorporated in the work.

1.2.5.3 VARIATIONS

After design submittals have been reviewed and cleared for construction by the Contracting Officer, no submittal for the purpose of substituting materials, equipment, systems, and patented processes will be considered by the Government unless submitted in accordance with the paragraph entitled VARIATIONS.

1.2.5.4 ADDITIONAL SHOP DRAWINGS AND SUBMITTALS

In accordance with the paragraph entitled DESIGN DISCREPANCIES, the Government may request the Site-Adapt Contractor to provide additional shop drawing and submittal type data subsequent to completion of the design.

1.2.5.5 INCOMPLETE DESIGN

The Site-Adapt Contractor shall not use construction submittals as a means to supplant and/or supplement an incomplete design effort.

1.3 SUBMITTAL CERTIFICATION

The CQC organization shall be responsible for certifying that all submittals and deliverables have been reviewed in detail for completeness, are correct, and are in strict conformance with the contract drawings, specifications, and reference documents.

1.3.1 EFFECTIVE QUALITY CONTROL SYSTEM

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with Contract Clause 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION - ALTERNATE I, and SECTION 01451 CONTRACTOR QUALITY CONTROL.

1.3.1.1 ORGANIZATIONAL RESPONSIBILITY

The quality control system shall cover all design, construction, subcontractor, manufacturer, vendor, and supplier operations at any tier, both onsite and offsite.

1.3.1.2 CQC SYSTEM MANAGER REVIEW AND APPROVAL

Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager. If found to be in strict conformance with the contract requirement, each item shall be stamped, signed, and dated by the CQC System Manager. Copies of the CQC organizations review comments indicating action taken shall be included within each submittal.

1.3.1.3 DETERMINATION OF COMPLIANCE

Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements by the Contracting Officer. The contractor shall submit all required documentation with submittals. The U.S. Army Corps of Engineer (USACE) will not accept partial submittals.

1.3.2 RESPONSIBILITY FOR ERRORS OR OMISSIONS

It is the sole responsibility of the Contractor to ensure that submittals do or do not comply with the contract documents. Government review, clearance for construction, or approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract.

1.3.2.1 GOVERNMENT REVIEW

Government review, clearance for construction, or approval of post design construction submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory.

1.3.3 SUBSTITUTIONS

After design submittals have been reviewed and cleared for construction by the Contracting Officer, no re-submittal for the purpose of substituting materials or equipment will be considered unless justified as indicated in the paragraph entitled, “VARIATIONS.”

1.3.4 ADDITIONAL SUBMITTALS

In conjunction with Contract Clause 52.236-5 MATERIAL AND WORKMANSHIP, the Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work.

1.3.5 UNTIMELY AND UNACCEPTABLE SUBMITTALS

If the Contractor fails to submit submittals in a timely fashion, or repetitively submits submittals that are incomplete or not in strict conformance with the contract documents, no part of the time lost due to such actions shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

1.3.6 STAMPS

Stamps shall be used by the Contractor on all design and post design construction submittals to certify that the submittal meets contract requirements and shall be similar to the following:

Contractor (Firm Name)
Contract Number
Contract Name

I certify that this submittal accurate, is in strict conformance with all contract requirements, has been thoroughly coordinated and cross checked against all other applicable disciplines to prevent the omission of vital information, that all conflicts have been resolved, and that repetition has been avoided and, it is complete and in sufficient detail to allow ready determination of compliance with contract requirements by the Contracting Officer.

Name of CQC System Manager: _____
Signature of CQC System Manager: _____
Date: _____

1.4 ENGLISH LANGUAGE

All specifications, drawings, design analysis, design calculations, shop drawings, catalog data, materials lists, and equipment schedules submitted shall be in the English language.

1.5 UNITS OF MEASUREMENT

Design documents shall be prepared in accordance with the guidance offered in SECTION 01415 METRIC MEASUREMENTS.

The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the 11th CGPM in 1960.

1.5.1 DRAWINGS

1.5.1.1 1.5.1.1 SITE LAYOUT

All site layout data shall be dimensioned in meters or coordinates, as appropriate. All details and pipe sizes shall be dimensioned in millimeters.

EXAMPLE: Masonry openings shall be a U.S. module to suit a standard U.S. door. The dimensions of the opening shall be given in SI units. Metric dimensions for site plans shall be in meters and fraction thereof. Dimensions for all other drawings shall be in millimeters using hard metric designations (example: 12 meters = 12 000). Hard metric is defined as utilizing standard metric products and the use of measurements in increments of fifty (50) and one hundred (100) millimeters.

1.5.1.2 GEO-REFERENCE

All site plans shall be geo-referenced using the WGS 1984 coordinate system, specifically the following: WGS 1984 UTM one 42 N. If the designer is not able to use the stated coordinate system the coordinate system used shall be correlated to the stated coordinate system. A table shall be provided within the site drawing set cross referencing the WGS84 system to that utilized. This is required to allow AED to incorporate the plans into GIS for storage, map production, and possible geospatial analysis of the different work sites.

1.5.2 DESIGN CALCULATIONS

Calculations shall be in SI units to meet the requirements of the design. Quantities on the contract drawings stated in SI units shall also be stated in SI units in the design analysis to match the drawings.

1.5.3 SPECIFICATIONS

All equipment and products shall be specified according to U.S. standards and described by appropriate units as required herein.

1.6 WITHHOLDING OF PAYMENT FOR SUBMITTALS

1.6.1 DESIGN SUBMITTALS

Payment for Design work will not be made in whole or in part until the Government has reviewed and cleared the design for construction.

1.6.2 CONSTRUCTION SUBMITTALS

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. In event under separate clause of the contract, the Contractor is allowed partial or total invoice payment for materials shipped from the Continental United States (CONUS), and/or stored at the site, the Contractor shall with his request for such payment, submit copies of approvals (ENG Form 4025) certifying that the materials that are being shipped and/or stored have been approved and are in full compliance with the contract technical specifications.

2.0 PRODUCTS

2.1 GENERAL

The following are contract deliverables which expound upon and finalize the design parameters/requirements outlined within the contract documents. They shall be prepared in such a fashion that the Prime Contractor is responsible to the Government and not as an internal document between the Prime Contractor and its Subcontractors, Vendors, Suppliers, etc.

2.2 PROJECT NARRATIVE

The Project Narrative shall be a bound set and shall contain the contract Request For Proposal (RFP) Sections 01010 and 01015 (and any additional RFP sections that are appropriate). The RFP Section 01010 and 01015 shall be the latest version. Any subsequent changes to the RFP shall be clearly marked and highlighted with explanation for the changes. The Project Narrative shall also contain the general description of the project and a discussion of the design approach and design features for the project.

2.3 DESIGN ANALYSIS

2.3.1 SUBMITTAL

Only design analyses associated with the "Site Adapt" features of this contract shall be submitted for review. It shall be written in the English language with SI units of measure. The design analysis is a written explanation of the project design which is expanded and revised (updated) as the design progresses. The design analysis shall contain all explanatory material giving the design rationale for any design decisions which would not be obvious to an engineer reviewing the final drawings and specifications. The design analysis contains the criteria for, and the history of, the project design, including criteria furnished by the Government, letters, codes, references, conference minutes, and pertinent research. Design calculations, computerized and manual, are included in the design analysis. Narrative descriptions of design solutions are also included. Written material may be illustrated by diagrams and sketches to convey design concepts. Catalog cuts and manufacturer's data for all equipment items, shall be submitted. Specific requirements for the design analysis, listed by submittal phase, are noted in Paragraph 1.2.1.

2.3.2 FORMAT

Format of design analysis shall closely match the standard format referenced within the RFP.

2.4 DESIGN CALCULATIONS

Only calculations associated with the "Site Adapt" features of this contract shall be submitted for review, unless site conditions mandate changes to drawings and specifications furnished with this Contract. All design calculations shall be presented such that they are easily understood, correlated with RFP requirements (Section 1010 and 1015 criteria; codes; all other applicable or pertinent criteria) and all final conclusions clearly documented and summarized. The Design Submittal must include complete information (Soil Report, percolation test results, concrete design strengths, steel material properties, electrical loads, heat gain/loss assumptions, etc.) necessary to support all design calculations in order to easily and efficiently verify the accuracy of this information and the resulting project components shown in plans and specifications.

2.4.1 SUBMITTAL

When design calculations are voluminous, they shall be bound separately from the narrative part of the design analysis. Design calculations will include a title page, table of contents, and be indexed (tabbed)

to separate distinct parts of the various analysis and design actions being accomplished to support plan drawings submitted. They shall be presented in a clear, consistent and legible format in order to quickly understand the analysis and design accomplished. Presentation shall be such that a person unfamiliar with the project features and associated analysis and design can quickly understand the overall design process and procedures, review the information in conjunction with the given set of plans and specifications, and verify the suitability of all information submitted.

All design calculations shall explain the source of loading conditions with assumptions and conclusions explained. The analysis and design methods shall also be explained, including assumptions, theories and formulae. Include applicable diagrams that are clearly explained and correlated with related computations, whether computer or hand generated. The design calculations shall include a complete and comprehensive list of the criteria (and date or version of the criteria) that the design/analysis will be compared to (codes, Corps of Engineers Engineering Regulations, Engineering Manuals, etc.). Within the separable elements of design calculations, the engineer shall cite the specific code or reference paragraph or section as appropriate to indicate conformance to requirements.

At the beginning of each project component design section, present a summary of all load conditions and combinations required per applicable code or Corps of Engineers manual or regulation. Then clearly identify the particular load case governing the design and clearly show how the particular analysis, construction materials to be used, and the specific design meet the governing load combination.

Calculation sheets shall carry the names or initials of the engineer and the checker and the dates of calculations and checking. No portion of the calculations shall be computed and checked by the same person.

2.4.2 COMPUTER ANALYSIS

Provide a clear summary of all computer outputs and highlight in the outputs information used in the analysis and design accomplished elsewhere in the calculations.

If a computerized analysis or design program is used (either commercial software packages or unique, designer-written computer analysis/design tools), the computations shall provide clear reference to the software program and version being used and an explanation of the validity of the particular program to the given application (where has the program been used before, what input and output does the program provide, is the program a recognized Corps of Engineers or industry standard). If the program is proprietary to the Contractor (not recognized by the Corps of Engineers or industry), the Contractor shall provide a sample hand calculation to verify the results of one set of data generated by the computer program.

State exactly the computation performed by the computer. Include applicable diagrams, adequately identified. Provide all necessary explanations of the computer printout format, symbols, and abbreviations. Use adequate and consistent notation. Provide sufficient information to permit manual checks of the results.

Each set of computer printouts shall be preceded by an index and by a description of the computation performed. If several sets of computations are submitted, they shall be accompanied by a general table of contents in addition to the individual indices.

When the computer output is large, it shall be divided into volumes at logical division points. All final computer results used in design shall be separated from the total pages of computer output that might be included in the design calculations for ease of review.

2.5 SPECIFICATIONS

Specifications for most work associated with this Contract may have been furnished to the Contractor and only portions of them (if provided) should be submitted for review with the "Site Adapt" portion of the work. If the Contractor determines that work associated with the "Site Adapt" features of this contract require additional specifications, they shall be submitted for review and approval. Specifications shall be prepared in accordance with the UFGS (Uniform Facilities Guide Specifications)

format. The Contractor-prepared specifications shall include as a minimum, all applicable specification sections referenced by the UFGS. Where the does not reference a specification section for specific work to be performed by this contract, the Site-Adapt Contractor shall be responsible for creating the required specification in the UFGS format.

2.5.1 USE OF UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)

If additional specifications are deemed necessary by the Contractor, UFGS (Uniform Federal Guide Specifications) are required when U.S. products and systems are required or used. Current UFGS information may be obtained at the following location: http://www.wbdg.org/ccb/browse_org.php?o=70.

Specifications for UFGS are in SpecsIntact format. SpecsIntact is government sponsored software used to edit specifications for government contracts. The software is available at the following link: http://specsintact.ksc.nasa.gov/index.asp.

2.5.2 QUALITY CONTROL AND TESTING

Any additional specifications deemed necessary by the Contractor shall include required quality control and further indicate all testing to be conducted by the Contractor, its subcontractors, vendors and/or suppliers.

2.5.3 AMBIGUITIES AND INDEFINITE SPECIFICATIONS

Ambiguities, indefinite specification requirements (e.g., highest quality, workmanlike manner, as necessary, where appropriate, as directed etc) and language open to interpretation is unacceptable.

2.5.4 INDUSTRY STANDARDS

2.5.4.1 U.S. INDUSTRY STANDARDS

The Specifications shall be based on internationally accepted U.S. industry Standards. Customarily accepted publications may be found in the UNIFIED MASTER REFERENCE LIST (UMRL) which may be located at the following URL: http://www.hnd.usace.army.mil/techinfo/UFGS/UFGSref.htm.

To access the UMRL select the “Unified Facilities Guide Specifications” tab and scroll down to Unified Master Reference List (UMRL) (PDF version).

Examples of U.S. standards are: National Fire Protection Association (NFPA), International Building Code (IBC), American Concrete Institute (ACI), American Water Works Association (AWWA), ADAAG (ADA Accessibility Guidelines) for Buildings and Facilities, etc. Standards referenced shall be by specific issue; the revision letter, date or other specific identification shall be included.

This document lists publications referenced in the Unified Facilities Guide Specifications (UFGS) of the Corps of Engineers (USACE), the Naval Facilities Engineering Command (NAVFAC), the Air Force Civil Engineer Support Agency (AFCESA), and the guide specifications of the National Aeronautics and Space Administration (NASA). This document is maintained by the National Institute of Building Sciences (NIBS) based on information provided by the agencies involved and the standards producing organizations. The listing is current with information available to NIBS on the date of this publication.

Standards referenced in specifications and drawings prepared by the Contractor shall be by specific issue; the revision letter, date or other specific identification shall be included.

2.5.5 AED DESIGN REQUIREMENTS DOCUMENTS

AED Design Requirements (latest version) documents listed in section 01015, shall be adhered to in this contract. These documents are available from the COR. These documents shall be used as the basis for design and construction, and for selecting options within the United Facilities Guide Specifications (UFGS). It is the contractor’s option to use specifications contained in the AED Design Requirements

Documents, when provided, or to adapt the UFGS specifications to match the requirements provided in the AED Design Documents and specifications. Site or project specific data and requirements in the AED Design Requirements documents shall supersede UFGS language where there are differing criteria which must be evaluated and selected.

2.6 DRAWINGS

2.6.1 COMPUTER ASSISTED DESIGN AND DRAFTING (CAD)

Computer Assisted Design and Drafting (CAD) is required for all Afghanistan Engineer District-North contracts. Only personnel proficient in the preparation of CAD drawings shall be employed to modify the contract drawings or prepare new drawings. The CAD deliverables shall meet the requirements of the A/E/C CAD Standards (V 3.0 or newer). The A/E/C CAD Standards may be downloaded at the CAD/BIM Technology Center at the following link: https://cadbim.usace.army.mil/default.aspx?p=s&t=13&i=4 or the AED-N website http://www.aed.usace.army.mil/engineeringtop2010.asp under the "Government Provided CAD Files" link.

. The Contractor shall furnish all softcopy design submittals (and As-Builts) using software applications in either DWG format (Auto Desk, AutoCad Release 2009 or newer) or DGN format (Bentley Systems, MicroStation, version 8.0 or newer). Use of unregistered or student copies of software applications to prepare design drawings **IS NOT PERMITTED**. In addition, the Contractor is required to submit the softcopy design submittals in PDF (Adobe Acrobat) format.

CD media submitted containing the softcopy design submittals shall be organized per the instructions below and the diagram in Section 1335a:

CD Title:

Project Name and Location:
Project Number:
Submittal Number:
Date:
Contractor Name, Address, Telephone Number and email

Folders and Folder Contents/Structure:

Main Folder Name	Subfolders, Files and File Format	Description
Administrative	Multiple PDF files	Files shall include the contract, task order, approved modifications, approved BCDs, approved variations and non-administrative modifications (do not provide time extensions, COR appointments, and Requests for Information/responses, etc).
Design Analysis	One pdf file with identical contents as the printed document of the submittal.	All data, discussion, calculations and information presented in the printed Design analysis.
Specifications	One folder specifications in word format. One folder with specifications in pdf format.	All specification sections including table of contents edited as appropriate for the submittal stage of the project[2].
Geotechnical Report	One file in pdf format	All data, graphs, charts and tables generated during the geotechnical investigation.

PDF Drawings	One Binder of pdf files.	PDF Drawings. Files will be saved in a Binder and organized in the same order as indicated on the sheet index
CAD Drawings	DGN or DWG files organized in the following folders. Each folder shall contain only drawings pertaining to that discipline. General (Cover Sheet/ Index of Drawings, Vicinity Maps) Civil Architectural Structural Mechanical Plumbing Electrical Telecommunications	CAD Drawings. All referenced files are to be attached without drive or directories and placed in the same folder it is referencing. Do not save or use paths. Do not use live nesting when attaching reference files.

Notes:
1. The administrative folder shall provide documents submitted by the contractor and received from the COR related to the contract. These documents shall include Requests for Information related to design issues, Variation Requests, Modifications to the Contract. In addition, the folder shall contain a copy of the signed contract, relevant task orders and change orders.
2. DO NOT INCLUDE standard drawings or specifications provided to the contractor as part of the RFP or as part of the contract.

2.6.2 DRAWINGS

Drawings shall be prepared in the English language with metric (SI) units of measure. All drawings and details of the working drawings shall be labeled and cross-referenced, thoroughly checked and coordinated with other engineering disciplines. At the final design submittal (100%) the Contractor shall have incorporated all design review comments generated by previous design review(s), have completed all of the constructability and coordination comments, and have the drawings in a Ready-to-Build condition. The drawings shall be complete at this time and contain all the details necessary to ensure a clear understanding of the work throughout construction. Prior to submitting the 100% Final Design drawings, the Contractor shall follow the procedures as described in Section 3 of the AED Design Requirements for CAD Design Guide.

2.6.3 DRAWING SIZE BORDER SHEETS

All drawings shall be prepared in size "A1" border sheets (594mm by 841mm). Hardcopy design submissions may be printed on half size drawing sheets (“A3”, 297 mm by 420 mm) for purposes of saving paper and for ease of review. If drawings are not readable in the half size reduction, the Contractor shall submit all drawings in A1 border sheets. All final contract drawing sets (As-Builts) shall be submitted on A1 border sheets. Drawing sheets shall be trimmed to specified size if necessary.

2.6.4 SEQUENCE OF DESIGN DRAWINGS

Referencing the A/E/C CAD Standard the sequence of drawings shall follow the sequence as shown below:

Discipline

1. General
2. Hazardous Materials
3. Survey/Mapping
4. Geotechnical
5. Civil
6. Landscape
7. Structural
8. Architectural
9. Interiors
10. Equipment
11. Fire Protection
12. Plumbing
13. Process
14. Mechanical
15. Electrical
16. Telecommunications
17. Resource
18. Other Disciplines
19. Sub-Contractor/Shop Drawings
20. Operations

2.6.5 DRAWING FOLDER STRUCTURE

CAD files shall be organized in folder names as described in Paragraph 2.6.4. For multi-building projects, a folder of each building type shall be created and the applicable folders shown in each building type folder.

2.6.6 DRAWING SHEET ASSEMBLY

CAD files will be organized in what is described as "**Option 1a**" (page 9 in the A/E/C CAD Standards Drawing Sheet Assembly manual), normally referred to as "Model Space and Paper Space" in Autodesk Autocad applications and "Design Model and Sheet Model" in Bentley Microstation applications. All files will be drawn consistently in the same manner using this option throughout the entire project.

2.6.7 MODEL FILES

Model files represent the building's physical layout and components such as floor plans, elevations and details. Model files shall be drawn to full size (1:1) in metric units in the default model view. Floor Plan Model files represent one floor. Example: do not use one model drawing file to draw several floor plan drawings with several border files. (One paperspace layout per plotted sheet.) Model files being referenced into another shall have insertion coordinates (x,y,z) of 0,0,0 in model space. The exception for model files with insertion coordinates other than 0,0,0 shall be the civil site plans (using Georeferencing and real-world coordinates.) Dimensioning shall be in millimeters unless noted otherwise, drawn

associatively, and not be “forced”. Example: if a wall is drawn 1:1 as 150 mm but the dimensioned number is modified to 200, this is unacceptable.

2.6.8 BORDER SHEET FILES

Border sheet files are referenced into drawing files (in PaperSpace) for plotting and viewing purposes. Every border sheet file has a drawing area, Title Block information and sheet trim border. The Afghanistan Engineer District – North uses a common Title Block sheet border for each project. The project Title Block sheet border with "sheet independent" data is referenced into each drawing. When a drawing file is created, "sheet dependent" Title Block data, such as the Sheet Identification and Title, is added to the specific drawing file and located in PaperSpacewhere the Title Block is referenced and viewed. AED-N Title Block drawings may be downloaded at : http://www.aed.usace.army.mil/engineeringtop2010.asp under the “Government Provided CAD Files” link.

2.6.9 LAYER/LEVEL NAMES

Layer or level files names shall follow the guidelines of the A/E/C CAD Standards V4.0. For AutoCAD, [discipline].dwt (drawing template files) shall be used to import the proper layers that will be inclusive of the correct line type, color, and line thickness of the respective layer. Templates to be used are found on the CAD/BIM Technology Center at the following link: https://cadbim.usace.army.mil/default.aspx?p=s&t=13&i=4, or at AED-N’s website: http://www.aed.usace.army.mil/engineeringtop2010.asp under the “Government Provided CAD Files” link.

2.6.10 DRAWING FILE NAMING CONVENTION

The sheet identifier will consist of the discipline designator, the sheet type designator and the sheet sequence number as referenced in the A/E/C CAD Standards V4.0.

2.6.11 SHEET IDENTIFICATION BLOCK

The sheet identifier will follow the format of the border sheet file. This will consist of the discipline designator, the sheet type designator and the sheet sequence number as referenced in the A/E/C CAD Standards Manual.

2.6.12 DRAWING SCALES

The scales indicated on the following list shall be the guide in determining the scale for all drawings. Bar scales on drawings are preferred as printed copies may lose their plotted scale through generational copying. The Contractor may, at its option, make exceptions to the scales indicated, if approved in writing by the Contracting Officer.

TYPICAL DRAWING SCALES	
DRAWING TYPE	**METRIC**
SITE PLAN	1:200
	1:400
	1:500
	1:600

	1:700
	1:1000
	1:2000
	1:5000
	1:6000
	1:10000
	1:20000
FLOOR PLAN	1:50
	1:100
ROOF PLAN	1:200
EXTERIOR ELEVATIONS	1:100
	1:200
INTERIOR ELEVATIONS	1:50
	1:100
CROSS SECTIONS	1:50
	1:100
	1:200
WALL SECTIONS	1:20
STAIR DETAILS	1:10
DETAILS	1:5

2.6.13 SYMBOLS, LINE STYLES, & PATTERNS

Approved symbols, line styles, and patterns shall be in accordance with AEC CAD Standards V 3.0 or newer (see Appendix D of the A/E/C CAD Standards). The approved symbols, line styles, and patterns associated with AutoCAD software maybe downloaded at the following link:

https://tsc.wes.army.mil/products/standards/aec/aecstdsym.asp

2.6.14 PLOTTER PREPARED ORIGINAL DRAWINGS AND PDF FILES

Design files shall be developed in anticipation of plotting on a monochrome, vector plotter. Line density shall be equivalent to that produced by black India ink: half tone plots are only acceptable where the half-tone color setting of RGB (red, green blue) settings equal a value of 153 . (Please refer to the A/E/C CAD Standards). **Drawings plotted in color are not acceptable.** Manual changes to plotted originals are not acceptable. A separate Adobe PDF file shall be made of each drawing file oriented in “Landscape”. Each PDF drawing file shall then be compiled into one “binder” PDF file for each set of drawings Following the order of the Sheet Index.

2.6.15 TITLE AND REVISION BLOCK

Only AED-N Title and Revision Blocks are allowed. These are available at AED-N's website for download at: http://www.aed.usace.army.mil/engineeringtop2010.asp under the "Government Provided CAD Files" link.

2.6.16 LEGENDS

For each submittal, legends of symbols and lists of abbreviations shall be placed on the drawings. They shall include all of the symbols and abbreviations used in the drawing set, but shall exclude any symbols and abbreviations not used. Since many symbols are limited to certain design disciplines, there is a definite advantage to the use of separate legends on the initial sheet of each design discipline or in the Standard Details package for each discipline. If legends have not been shown by discipline, a legend shall be placed on the first drawing.

2.6.17 LOCATION/COLUMN GRID

To facilitate the location of project elements and the coordination of the various disciplines' drawings, all plans shall indicate a column line or planning grid, and all floor plans (except structural plans) shall show room numbers.

2.6.18 COMPOSITE AND KEY PLANS

If the plan of a large building or structure must be placed on two or more sheets in order to maintain proper scale, the overall plan (key plan) shall be placed on one sheet at a smaller scale to accommodate entire building/site. Key plans shall be used not only to relate large scale plans to total floor plans but also to relate individual buildings to large complexes of buildings. This key plan with match lines shall be referenced on all segmented drawings and shall be placed in a convenient location to indicate the relative location of the represented plan area by crosshatching.

2.6.19 SPECIFICATIONS PLACED ON THE DRAWINGS

Details of standard products or items which are adequately covered by specifications shall not be included on the drawings.

2.6.20 REVISIONS

Drawing revisions shall be prepared only on the original CAD files. A revision history (located in the Title Block) is required on all sheets.

2.6.21 BINDING

All volumes of drawing prints shall be firmly bound and shall have covers of heavier bond than the drawing sheets. If posts are used to fasten sheets together, the drilled holes on the bond edges of the sheets shall be on 8-1/2-inch centers.

2.6.22 GOVERNMENT PROVIDED FILES

All CAD related files provided by the Government to the Contractor (AutoCad and MicroStation Afghanistan Engineering District-North Title Block and Cover/Index sheet files, AutoCAD template files) may be downloaded through the following Afghanistan Engineering District-North website:

http://www.aed.usace.army.mil/engineeringtop2010.asp under the "Government Provided CAD Files" link.

If Contractor is unable to access this site, a CD will be provided upon request to the Project Manager.

3.0 EXECUTION

3.1 GENERAL

3.1.1 DESIGN CONCEPT COORDINATION MEETING

Shortly after Notice To Proceed (NTP) the Government or contractor may suggest meeting(s) to review the Design Submittal process or discuss various aspects of the contract to enable prompt and efficient initiation of contract actions. Meeting(s) will be held to assure attention is focused on key project requirements (necessary contractor design and Government review that is required to provide Construction Clearance), to discuss features and items of work that need to be submitted early due to long lead time items, or discuss other concepts/ideas that will help accelerate the contract work. Other Design Coordination meetings may be requested throughout the contract period if Government review of various contractor Design Submittals indicate poor design and plan or specification quality in order to clearly explain the changes and improvements required of the contractor, assure understanding of Government comments, code references and required investigations and calculations, to move forward with acceptable design and satisfactory plans and specifications.

3.1.2 GOVERNMENT DESIGN CHANGES

Government design changes which do not increase construction costs shall be made at no charge to the Government. The Contracting Officer may request design submittals in addition to those listed when deemed necessary to adequately describe the work covered in the contract documents. Submittals shall be made in the respective number of copies and to the respective addresses set forth in the paragraph entitled SUBMITTAL PROCEDURE. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

3.2 SUBMITTAL REGISTER

3.2.1 DESIGN SUBMITTALS

The Contractor shall submit as part of his Project Schedule Design Submittal milestone dates. The Contractor shall post all actual dates of submittal actions (including clearance for construction) as they occur.

3.2.2 CONSTRUCTION SUBMITTAL REGISTER (ENG FORM 4288)

Attached to this section is ENG Form 4288 which the Contractor is responsible for developing for this contract. All design and construction submittals shall be shown on this register. The submittal register shall be the controlling document and will be used to control all submittals throughout the life of the contract. The Contractor shall maintain and update the register on a monthly basis for the Contracting Officer's approval.

3.3 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both design and construction submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care will be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.4 PROGRESS SCHEDULE

The Contractor shall prepare and submit a design progress schedule to the Contracting Officer. The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The progress schedule shall show, as a percentage of the total design price, the various items included in the contract and the order in which the Contractor proposes to carry on the work, with dates on which he will start the features of the work and the contemplated dates for completing same. Significant milestones such as review submittals shall be annotated. The Contractor shall assign sufficient technical, supervisory and administrative personnel to insure the prosecution of the work in accordance with the progress schedule. The Contractor shall correct the progress schedule at the end of each month and submit as required to the Contracting Officer. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.5 SCHEDULING

3.5.1 DESIGN SUBMITTALS

Adequate time (a minimum of fourteen (14) full calendar days exclusive of mailing time) shall be allowed for AED review and comment in DrChecks$_{SM}$. This time period starts on the next full day after delivery of the Design Submittal to AED. If the Contractor fails to submit design submittals in a timely fashion, or repetitively submits design submittals that are not in strict conformance with the Contract documents, no part of the time lost due to such actions shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.5.2 CONSTRUCTION SUBMITTALS

Contractor furnished Government Approved Construction Submittals (GA) for items noted in Paragraph 1.2.5 of this Section, or others as required by the COR, shall be submitted to the Area or Resident Office, per directions given at the Pre-Construction meeting. Adequate time (a minimum of fourteen (14) full calendar days exclusive of mailing time) shall be allowed for AED review and comment.

3.5.3 POST DESIGN CONSTRUCTION SUBMITTALS

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of fourteen (14) full calendar days exclusive of mailing time) shall be allowed for review and approval. If the Contractor fails to submit post design construction submittals in a timely fashion, or repetitively submits submittals that are not in strict conformance with the Contract documents, no part of the time lost due to actions shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.6 SUBMITTAL PROCEDURE

3.6.1 DESIGN SUBMITTALS

3.6.1.1 AFGHANISTAN ENGINEER DISTRICT (AED)

One (1) half-size hard copy and two (2) soft copies (electronic version) of all design submittals (calculations, reports of field tests, design analysis, plans, specifications, etc) shall be transmitted to the Government at the following address, by means of ENG Form 4025:

AFGHANISTAN ENGINEER DISTRICT NORTH (AEN)

(1) DHL, FEDEX, UPS or any other courier service:
U.S. Army Corps of Engineers

Afghanistan Engineer District
House # 1, St. #1 West
West Wazir Akbar High School
Behind Amani High School
Kabul, Afghanistan
Attention: Chief, Engineering Branch

The soft copy (electronic version) and CD case shall both be clearly labeled (hand written information is not acceptable – typed labels are required) with contract information (contract #, title, contractor name, specific design submittal stage including if it is a Resubmittal, date of submission, components of the submittal – design analysis, plans, specifications, and if more than one CD then state 1 of "X", 2 of "X", etc., anti-virus information below, etc.)

The Contractor shall scan the soft copy (electronic version) of each Design Submittal using most up-to-date version of recognized Industry-standard anti-virus software (Symantec, Norton, etc.) to insure that no viruses are contained in it prior to acceptance by AED. The label shall indicate it has been scanned for viruses and the anti-virus software and version clearly indicated.

3.6.1.2 RESIDENT/AREA ENGINEER OFFICE

Complete design submittals shall be provided to the Area and/or Resident Engineer Office such that these are received **at the same time** as these submittals are delivered to the AED address in Para. 3.6.1.1. At the Pre-Construction meeting, the Contractor will be furnished the Area and/or Resident Office address to which these submittals shall be provided along with the number and size of hard and soft (electronic version) copies required for these offices. As per Paragraph 3.6.1.1, soft copies are to be properly labeled and checked for viruses by the contractor prior to delivery.

3.6.1.3 EDITABLE CAD FORMAT AS-BUILTS

This is a Site-Adapt project and in accordance with Contract Clause 52.227-7022 GOVERNMENT RIGHTS (UNLIMITED), the Government has non-exclusive rights to use the design on other projects. Therefore, the As-Builts furnished to the Government must be in an editable format. See Section 01780A CLOSEOUT SUBMITTALS, Paragraphs 1.1 and 1.2, for all requirements associated with submission of editable CAD format As-Builts required as part of this contract.

3.6.2 POST DESIGN CONSTRUCTION SUBMITTALS

One (1) copy of all post design construction submittals shall be transmitted to:

AFGHANISTAN ENGINEER DISTRICT NORTH (AEN)

(1) DHL, FEDEX, UPS or any other courier service:
U.S. Army Corps of Engineers
Afghanistan Engineer District
House # 1, St. #1 West
West Wazir Akbar High School
Behind Amani High School
Kabul, Afghanistan
Attention: Chief, Engineering Branch

3.6.3 SUBMITTAL NUMBERING SYSTEM

Instructions on the numbering system to be used for construction submittals follows.

3.6.3.1 SUBMITTALS

Shop drawings and materials are listed on the Submittal Register (ENG Form 4288) as follows:

a. List is prepared according to contract specifications and drawings, picking up all items involved in the project.

b. This list is divided into sections as indicated in the specifications. For example:

Section	01015	"Technical Requirements"
Section	01335	“Design Submittals”
Section	02831	"Chain-Link Fence"
Section	02710	"Sub-drainage System"
Section	03300	"Concrete For Building Construction"
Section	04200	"Masonry"

3.6.3.2 NUMBERING PROCEDURES FOR TRANSMITTAL ON ENG FORM 4025

Each Specification Section will have various requirements for submittals (design information, product data, test reports, procedures, etc.) to the Government for Approval (GA) or For Information Only (FIO). Items from different Sections cannot be submitted on the same ENG Form 4025. When furnishing one or more items from the same Section at a given time, a single ENG Form 4025 can be used to identify and submit these items. Block ‘b” of the 4025 entitled “DESCRIPTION OF ITEM SUBMITTED” should provide an accurate and unique description of each item being proposed by the Contractor. Item numbers (block “a” of the 4025 entitled “ITEM NO.”) will be automatically generated in QCS for each ENG Form 4025. QCS will track and automatically generate the “ITEM NO.” for all following ENG Form 4025s for the same Section number. To illustrate, a transmittal for the 65% Design Submittal required by Section 01335 might have the following Items:

ITEM NO. 1	Topographic Information
ITEM NO. 2	Geotechnical Report
ITEM NO. 3	Foundation Design
ITEM NO. 4	65% Plans
ITEM NO. 5	Outline of Construction Specifications to be used

If this was the first submittal furnished by the Contractor for Section 01335, then a Transmittal Number of 01335-1 would be generated using QCS. As new transmittals are generated in QCS, the last digit of the transmittal is increased incrementally, as follows:

Transmittal No. 01335-2

Transmittal No. 01335-3

Transmittal No. 01335-4

and so forth. The first transmittal submitted from each Specification Section will be “-1”, in other words, there will never be a “Transmittal No. 01335-0”.

The above illustration is true for all other Specification Sections included in the Request for Proposal or in the Construction Specifications compiled by the Contractor in the prosecution of work under the RFP.

3.6.3.3 RESUBMITTALS

Should the Contractor be required to resubmit any transmittal due to one or more items on that transmittal being Coded “C” (Cleared for Construction, except as noted in attached comments, Resubmission

Required) or “E” (NOT Cleared for Construction, see attached comments, resubmission required) by the Government, QCS will be used to generate the same transmittal number followed by the number "-1" for the first re-submittal, "-2" for the second re-submittal, "-3" for the third re-submittal, etc.

As an example, assume the 65% Design Submittal is provided to the Government as Transmittal 01335-9. Due to omissions or errors in that Submittal which result in a Code “E” being given, then the subsequent 65% Design Re-submittal #1 would be “Transmittal 01335-9.1”. Should a re-submittal again be necessary, it would be Design Re-submittal #2 and would be submitted as “Transmittal 01335-9.2”.

The purpose of this system is to avoid deviations from the Submittal Register and to track submittals in both RMS and DrChecks$_{SM}$. It should be noted that a new transmittal number following the above system CANNOT be generated in QCS unless the prior transmittal has been given a Code. If the Contractor is having difficulty generating the correct transmittal number, contact the COR to resolve the matter.

The Contractor use the above nomenclature and date of submission to the Government for Plan Cover Sheets; title blocks for all drawings; all Specification Cover Sheets; all specification pages; all Design Analysis Cover Sheets and associated pages; and similar labeling for all other documents included in the submittal.

See the attachment titled “SITE ADAPT 1335a-Attachments-AED.pdf” (Figures 1-4) for required Title Block Required Annotations drawing guidance.

3.6.4 VARIATIONS

If design or construction submittals show variations from the contract parameters and/or requirements, the Contractor shall justify such variations in writing, at the time of submission. Additionally, the Contractor shall also annotate block "h" entitled "variation" of ENG FORM 4025. After design submittals have been reviewed and cleared for construction by the Contracting Officer, no resubmittal for the purpose of substituting materials, equipment, systems, and patented processes will be considered unless accompanied by the following:

a. Reason or purpose for proposed variation, substitution, or revision.

b. How does quality of variation compare with quality of the specified item? This shall be in the form of a technical evaluation tabulating differences between the item(s) originally specified and what is proposed.

c. Provide a cost comparison. This shall include an acquisition and life cycle cost comparison.

d. For proprietary materials, products, systems, and patented processes a certification signed by an official authorized to certify in behalf of the manufacturing company that the proposed substitution meets or exceeds what was originally specified.

e. For all other actions, a certification signed by a licensed professional engineer or architect certifying that the proposed variation or revision meets or exceeds what was originally specified.

f. Advantage to the Government, if variation is approved, i.e. Operation and Maintenance considerations, better product, etc.

g. Ramifications and impact, if not approved.

If the Government review detects any items not in compliance with contract requirements or items requiring further clarification, the Contractor will be so advised. Lack of notification by the Contracting Officer of any non-complying item does not relieve the Contractor of any contractual obligation.

3.6.5 NON-COMPLIANCE

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

3.7 REVIEW OF CONTRACTOR PREPARED DESIGN DOCUMENTS

3.7.1 GENERAL

The work under contract will be subject to continuous review by representatives of the Contracting Officer. Additionally, joint design review conferences with representation by all organizations having a direct interest in the items under review may be held. The Contractor shall furnish copies of all drawings and related documents to be reviewed at the review conference on or before the date indicated by the Government. Additional conferences pertaining to specific problems may be requested by the Contractor or may be directed by the Contracting Officer as necessary to progress the work. The Contractor shall prepare minutes of all conferences and shall furnish two copies to the Contracting Officer within seven (7) days after the conference.

3.7.2 INDEPENDENT DESIGN REVIEW

The Contractor shall have someone other than the Designer or Design Team perform an independent technical review of all specifications, drawings, design analysis, calculations, and other required data prior to submission to the Government. This review shall insure the professional quality, technical accuracy, and the coordination of all design analysis, drawings and specifications, and other services furnished under this contract have been accomplished. Work must be organized in a manner that will assure thorough coordination between various details on drawings, between the various sections of the specifications, and between the drawings and specifications. The Contractor shall thoroughly cross-check and coordinate all work until he is professionally satisfied that no conflicts exist, vital information has not been omitted, and that indefinite language open to interpretation has been resolved. Upon completion of this review, the Contractor shall certify that each design submittal is complete, accurate, is in strict conformance with all contract requirements, that repetition has been avoided, that all conflicts have been resolved, and that the documents have thoroughly coordinated and cross checked against all the applicable disciplines to prevent the omission of vital information.

3.7.3 CONTRACTOR'S QUALITY CONTROL ORGANIZATION REVIEW

The Contractor shall thoroughly review each submittal prior to submission to the Contracting Officer to assure it is complete, correct and unified. This review shall be for the purposes of eliminating errors, interferences, and inconsistencies, and of incorporating design criteria, review comments, specifications, and any additional information required. The Contractor will give evidence of such review of all items in each submittal ENG Form 4025, by annotating Column “g” (titled “For Contractor Use Code”) of this Form with the letter “A,” meaning the Contractor has reviewed it and is indicating it is “Approved as Submitted”. Design submittals submitted to the Contracting Officer without evidence of the above requirements or the Contractor's certified approval will be returned for resubmission. No part of the time lost due to such resubmissions shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.7.4 GOVERNMENT REVIEW

a. Within 14 days after Notice to Proceed, the Contractor shall submit, for approval, a complete design schedule with all submittals and review times indicated in calendar dates. The Contractor shall update this schedule monthly. After receipt, the Government will be allowed fourteen (14) full days to review and comment on all Design Submittals, except as noted below. This time period starts on the next full day after delivery of the Design Submittal to AED.

b. If a design submittal is deficient (errors on ENG Form 4025; incorrect drawing title block information; missing or incomplete features required in the submittal; etc.), it will be returned immediately without further review for correction and resubmission. The review time will begin when the corrected submittal is received. The Contractor may be liable for liquidated damages owed to the Government for returned design submittals due to deficiencies.

c. The contractor shall not begin construction work until the Government has reviewed the Contractor's Design Submittal and cleared it for construction. Clearance for construction does not mean Government approval. Government review shall not be construed as a complete check but will evaluate the general design approach and adherence to contract parameters. The Government Review is often limited in time and scope. Therefore, the Contractor shall not consider any review performed by the Government as an excuse for incomplete work.

d. Upon completion of the review the Contractor will be notified by the Contracting Officer Representative that the DrChecks$_{SM}$ file is open for viewing and response to AED comments. The Contracting Officer will indicate whether the Design Submittal, or portions thereof, has or has not been cleared for construction using the following action codes:

A – Cleared for Construction

B – Cleared for Construction, except as noted in attached comments

C – Cleared for Construction, except as noted in attached comments, resubmission required

E - NOT Cleared for Construction, see attached comments, resubmission required

FX – Receipt acknowledged, does not comply as noted with contract requirements.

These codes shall NOT be used by the Contractor.

Design submittals Cleared for Construction by the Contracting Officer shall not relieve the Contractor from responsibility for any design errors or omissions and any liability associated with such errors, nor from responsibility for complying with the requirements of this contract.

3.7.4.1 INCORPORATION OF GOVERNMENT REVIEW COMMENTS

a. The Contractor shall review each comment, furnish a complete response in DrChecks$_{SM}$ as to how the comment will be addressed in the Design Analysis, Plans and Specifications, or other Design Submittal stipulations required in this Contract. The Contractor will then incorporate each comment into the design submittal along with other work required at the next Design Submittal stage. The Contractor shall furnish disposition of all comments in DrChecks$_{SM}$, with the next scheduled submittal. The disposition shall identify action taken with citation of location within the relevant design document. Generalized statements of intention such as "will comply" or "will revise the specification" are not acceptable. During the design review process, comments will be made on the design submittals that will change the drawings and specifications. The

Government will make no additional payments to the Contractor for the incorporation of comments. Review comments are considered part of the contract administration process.

b. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after close of review period in order that the comment can be resolved.

c. The Contractor is cautioned that if he believes the action required by any comment exceeds the requirements of this contract, he should flag the comment in DrChecks$_{SM}$ as a scope change, and notify the COR in writing immediately.

d. If a design submittal is over one (1) day late in accordance with the latest design schedule, the Government review period may be extended 7 days. Submittal date revisions must be made in writing at least five (5) days prior to the submittal.

3.7.4.2 CONFERENCES

As necessary, conferences will be conducted between the Contractor and the Government to resolve review comments.

A review conference may be held at the completion of AED review and subsequent Contractor response for each design submittal. The review conference will be held at the Corps District Office in Kabul, Afghanistan. The Contractor shall bring the personnel that developed the design submittal to the review conference.

3.7.4.3 DESIGN DEFICIENCIES

Design deficiencies noted by the Government shall be corrected prior to the start of design for subsequent features of work which may be affected by, or need to be built upon, the deficient design work.

3.7.5 DESIGN DISCREPANCIES

The Contractor shall be responsible for the correction of incomplete design data, omissions, and design discrepancies which become apparent during construction. The Contractor shall provide the Contracting Officer with a proposed recommendation for correcting a design error, within three (3) calendar days after notification by the Contracting Officer. The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the worksite, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor. Should extensions of design, fabrication plans and/or specific manufacturer's details be required as a result of a Government issued Change Order, the Government will make an equitable adjustment in accordance with Contract Clause 52.243-4 entitled CHANGES.

3.8 PHASED OR "FAST-TRACK" DESIGN

3.8.1 GENERAL

If approved by the Government, design and construction sequencing may be effected on an incremental basis as each approved phase or portion (e.g., demolition, geotechnical, site work, exterior utilities, foundations, substructure, superstructure, exterior closure, roofing, interior construction, mechanical, electrical, etc.) of the design is completed.

3.8.2 SEQUENCE OF DESIGN-CONSTRUCTION (FAST-TRACK)

After receipt of the Contract Notice to Proceed (NTP) the Contractor shall initiate design, comply with all design submission requirements and obtain Government review of each submission. The contractor may begin construction on portions of the work for which the Government has reviewed the final design submission and has determined satisfactory for purposes of beginning construction. The Contracting Officer will notify the Contractor when the design is cleared for construction. The Government will not grant any time extension for any design resubmittal required when, in the opinion of the Government, the initial submission failed to meet the minimum quality requirements as set forth in the contract.

3.8.3 NOTICE-TO-PROCEED FOR LIMITED CONSTRUCTION

If the Government allows the Contractor to proceed with limited construction based on pending minor revisions to the reviewed Final Design submission, no payment will be made for any in-place construction related to the pending revisions until they are completed, resubmitted and are satisfactory to the Government.

3.8.4 IN-PLACE CONSTRUCTION PAYMENT

No payment will be made for any in-place construction until all required submittals have been made, reviewed and are satisfactory to the Government.

3.8.5 COMMENCEMENT OF CONSTRUCTION

Construction of work may begin after receipt of the clearance for construction (Notice to Proceed) for each design phase. Any work performed by the Contractor prior to receipt of the clearance for construction, shall be at the Contractor's own risk and expense. Work cleared for construction that does not conform to the design parameters and/or requirements of this contract shall be corrected by the Contractor at no additional cost or time to the Government.

3.9 CONDUCT OF WORK

3.9.1 PERFORMANCE

Perform the work diligently and aggressively, and promptly advise the Contracting Officer of all significant developments.

3.9.2 TELEPHONE CONVERSATIONS

Prepare a summary, and promptly furnish a copy thereof to the Contracting Officer, of all telephone conversations relating to the design work under this contract.

3.9.3 COOPERATION WITH OTHERS

Cooperate fully with other firms, consultants and contractors performing work under the program to which this contract pertains, upon being advised by the Contracting Officer that such firms or individuals have a legitimate interest in the program, have need-to-know status, and proper security clearance where required.

3.9.4 TECHNICAL CRITERIA

All designs, drawings, and specifications shall be prepared in accordance with the contract documents and with the applicable publications referenced therein. As soon as possible, the Contractor shall obtain copies of all publications applicable to this contract. Availability of publications (where to purchase) is contained in Specification Section 01420 entitled: SOURCES FOR REFERENCE PUBLICATIONS. Any

deviations from the technical criteria contained in the contract documents or in the applicable publications, including the use of criteria obtained from the user or other sources, must receive prior approval of the Contracting Officer. Where the technical criteria contained or referred to herein are not met, the Contractor will be required to conform his design to the same at his own time and expense.

3.9.5 CONFLICTS

Any conflicts, ambiguities, questions or problems encountered by the Contractor in following the criteria shall be immediately submitted in writing to the Contracting Officer with the Contractor's recommendations. Prior to submission to the Government the Contractor shall take appropriate measures to obtain clarification of design criteria requirements, to acquire all pertinent design information, and to incorporate such information in the work being performed.

3.9.6 DESIGN PRIORITIES

The design of this project shall consider the remote location and harsh environment of this project and the impact this will have on sources of technical supply, the cost of construction, the low level of maintenance, and the difficulty of obtaining replacement parts. Unless stated otherwise in this contract, the following design priorities shall be followed.

3.9.6.1 CONSTRUCTION LIFE SPAN

Permanent Construction. Buildings and facilities shall be designed and constructed to serve a life expectancy of more than 25 years, to be energy efficient, and to have finishes, materials, and systems that are low maintenance and low life cycle cost.

3.9.6.2 OPERABILITY

Systems including but not necessarily limited to mechanical, electrical, communications, etc., must be simple to operate and easy to maintain.

3.9.6.3 STANDARDIZATION

Use of standardized materials, products, equipment, and systems is necessary to minimize the requirements for replacement parts, storage facilities, and service requirements.

3.9.6.4 TOPOGRAPHIC SURVEYS, EASEMENTS, AND UTILITIES

Unless otherwise stated in the contract, the Contractor will be responsible for detailed topographic mapping, available easements, and utility information for the project.

3.9.6.5 HORIZONTAL AND VERTICAL CONTROL

The mapping shall be based on the base coordinate system. If the base system cannot be found, the surveyor shall use any established monuments. If monuments have been destroyed or do not exist, an assumed horizontal and vertical datum shall be established, using arbitrary coordinates of 10,000n and 10,000e and an elevation of 1,000 meters. The horizontal and vertical control established on site shall be a closed loop with third order accuracy and procedures. Provide three (3) concrete survey monuments at the survey site. All of the control points established at the site shall be plotted at the appropriate coordinate point and shall be identified by name or number, and adjusted elevations. The location of the project site, as determined by the surveyor shall be submitted in writing to the Contracting Officer. The site location shall be identified by temporary markers, approved by the Contracting Officer before proceeding with the surveying work.

3.9.6.6 TOPOGRAPHY REQUIREMENTS

A sufficient quantity of horizontal and vertical control shall be established to provide a detailed topographic survey at 1:500 scale with one quarter meter contour intervals minimum. Intermediate elevations shall be provided as necessary to show breaks in grade and changes in terrain.

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 contour interval and spot elevations shall be correct within plus or minus 20 millimeters.

Spot elevations affecting design of facilities shall be provided. Specifically, break points or control points in grades of terrain such as tops of hills, bottoms of ditches and gullies, high bank elevations, etc.

All surface and sub-surface structures features within the area to be surveyed shall be shown 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.

The location and sizes of potable, sanitary, electrical and mechanical utilities within the survey site shall be shown on the survey map. Sanitary manholes and appurtenances shall show top elevations and invert elevations.

3.9.7 OCCUPATIONAL SAFETY AND HEALTH ACT

The facilities, systems, and equipment designed under this contract shall comply with the Occupational Safety and Health Act (OSHA), Code of Federal Regulations, Title 29, Chapter XVII, Parts 1910 and 1926. Any problems in incorporating these standards due to conflicts with other technical criteria shall be submitted to the Contracting Officer for resolution.

3.9.8 ASBESTOS CONTAINING MATERIALS

Asbestos containing material (ACM) will not be used in the design of new structures or systems. In the event 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 AED.

3.9.8.1 EXISTING CONSTRUCTION

Asbestos containing materials (ACM) presently included in existing construction to be rehabilitated or otherwise modified as a result of this project shall be removed and a non-asbestos containing material substituted in lieu thereof.

3.9.8.2 SUSPECTED ASBESTOS CONTAINING MATERIALS

All such structures and systems shall be inspected to determine the presence or probable presence of ACM. When ACM is suspected, a documented survey will be performed. The survey will be developed into an abatement design and will be made a part of the design documents. In the event no other material is available which will perform the required function or the use of a substitute material would be cost prohibitive due to initial cost and tear-out of existing construction, a waiver for the retention of the asbestos containing material must be obtained from the Contracting Officer.

3.10 ATTACHMENTS

The following attachments form an integral part of this specification:

ENG FORM 4025-R, Mar 95 - Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificate of Compliance (2 pages)

ENG FORM 4288-R, Mar 95 - Submittal Register

Figure 1 – AED Title Block

Figure 2 – AED Management Block

Figure 3 – AED Issue Block & Required Notations

Figure 4 – Border Sheet Size

-- END OF SECTION -

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR ☐ FIO ☐ GOV'T. APPROVAL

ITEM NO. *a.*	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* *b.*	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. *(See instruction no. 8)* *c.*	NO. OF COPIES *d.*	CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO. *e.*	CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO. *f.*	FOR CONTRACTOR USE CODE *g.*	VARIATION *(See instruction No. 6)* *h.*	FOR CE USE CODE *i.*

REMARKS	**I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated.** _____ NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.

4. Submittals requiring expeditious handling will be submitted on a separate form.

5. Separate transmittal form will be used for submittals under separate sections of the specifications.

6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A	--	Approved as submitted.	E	--	Disapproved (See attached).
B	--	Approved, except as noted on drawings.	F	--	Receipt acknowledged.
C	--	Approved, except as noted on drawings. Refer to attached sheet resubmission required.	FX	--	Receipt acknowledged, does not comply as noted with contract requirements.
D	--	Will be returned by separate correspondence.	G	--	Other *(Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG Form 4025-R)

SUBMITTAL REGISTER

(ER 415 1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	CLASSIFICATION: INFORMATION ONLY o.	GOVERNMENT APPROVED p.	REVIEWER q.	CONTRACTOR SCHEDULE DATES: SUBMIT r.	APPROVAL NEEDED BY s.	MATERIAL NEEDED BY t.	CONTRACTOR ACTION: CODE u.	DATE v.	SUBMIT TO GOVERN-MENT w.	GOVERNMENT ACTION: CODE x.	DATE y.	REMARKS z.

ENG FORM 4288-R, MAR 95 EDITION OF SEP 93 IS OBSOLETE. PAGE 1 OF ____ PAGES (Proponent: CEMP-CE)

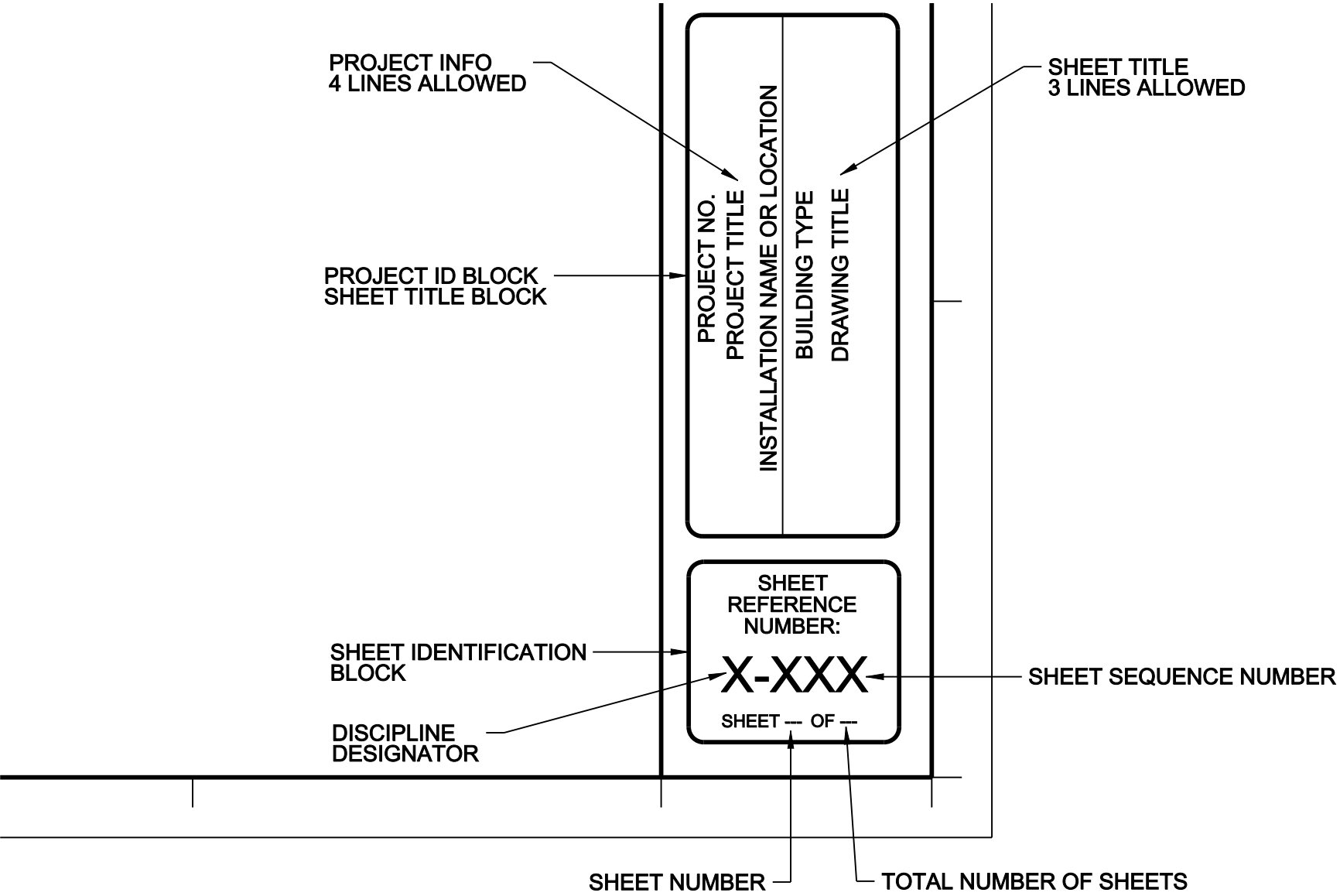


FIGURE 1 - AED TITLE BLOCK

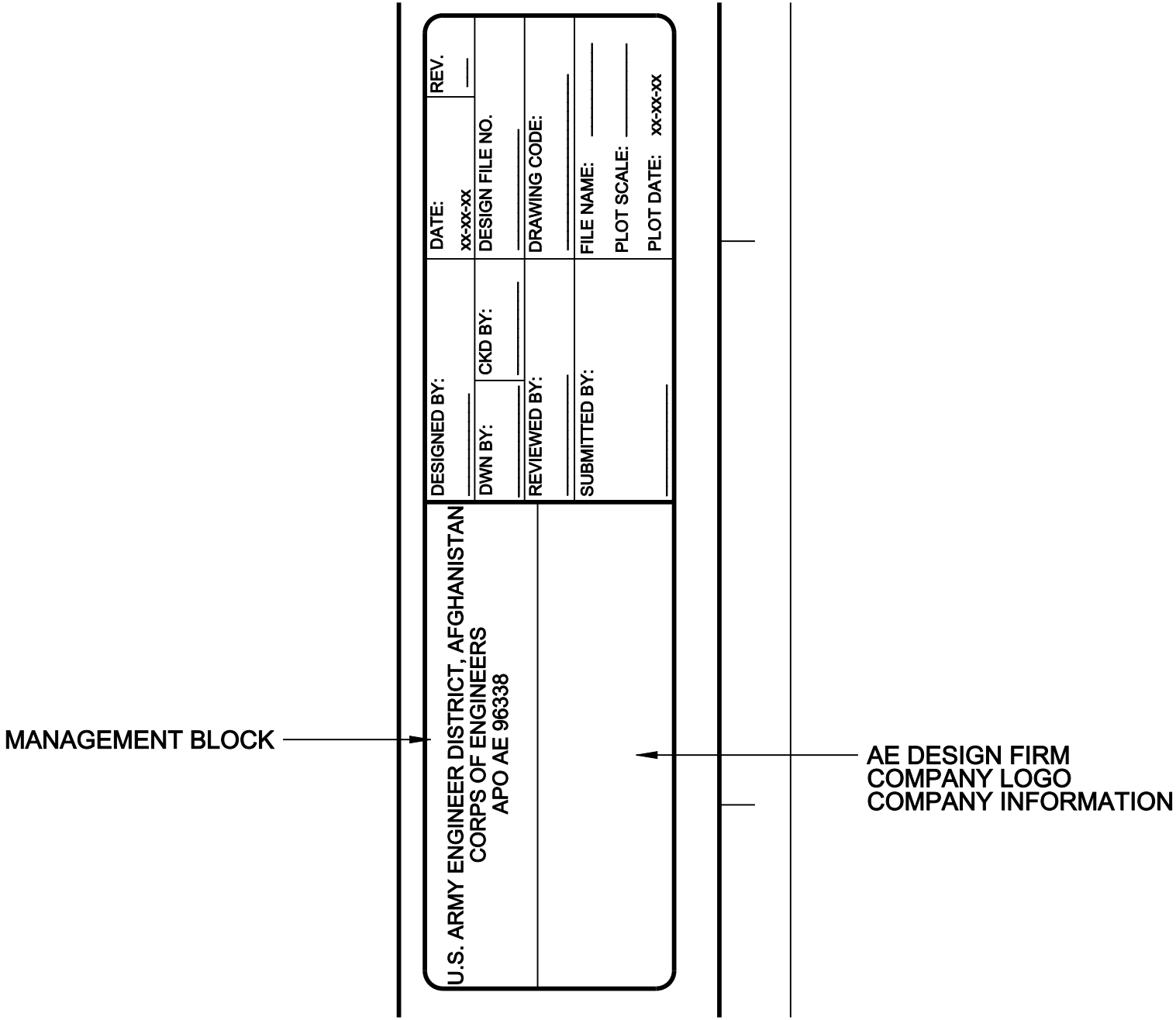


FIGURE 2 - AED MANAGEMENT BLOCK

H

DESIGNER IDENTIFICATION BLOCK (DO NOT ALTER)

US ARMY CORPS
OF ENGINEERS
AFGHANISTAN
ENGINEER DISTRICT

ISSUE BLOCK

SYMBOL	DESCRIPTION	DATE	APPR.	SYMBOL	DESCRIPTION	DATE	APPR.
	AS-BUILT SUBMITTAL	DATE					
	100% DESIGN SUBMITTAL	DATE					
	99% DESIGN RESUBMITTAL	DATE					
	99% DESIGN SUBMITTAL	DATE		4	REVISED AS-BUILT		
	65% DESIGN RESUBMITTAL	DATE		3	MOD P0003		
	65% DESIGN SUBMITTAL	DATE		2	MOD POOO2		
	35% DESIGN SUBMITTAL	DATE		1	AMENDMENT P0001		
		1 AUG 07					

FIGURE 3 - AED ISSUE BLOCK
& REQUIRED NOTATIONS

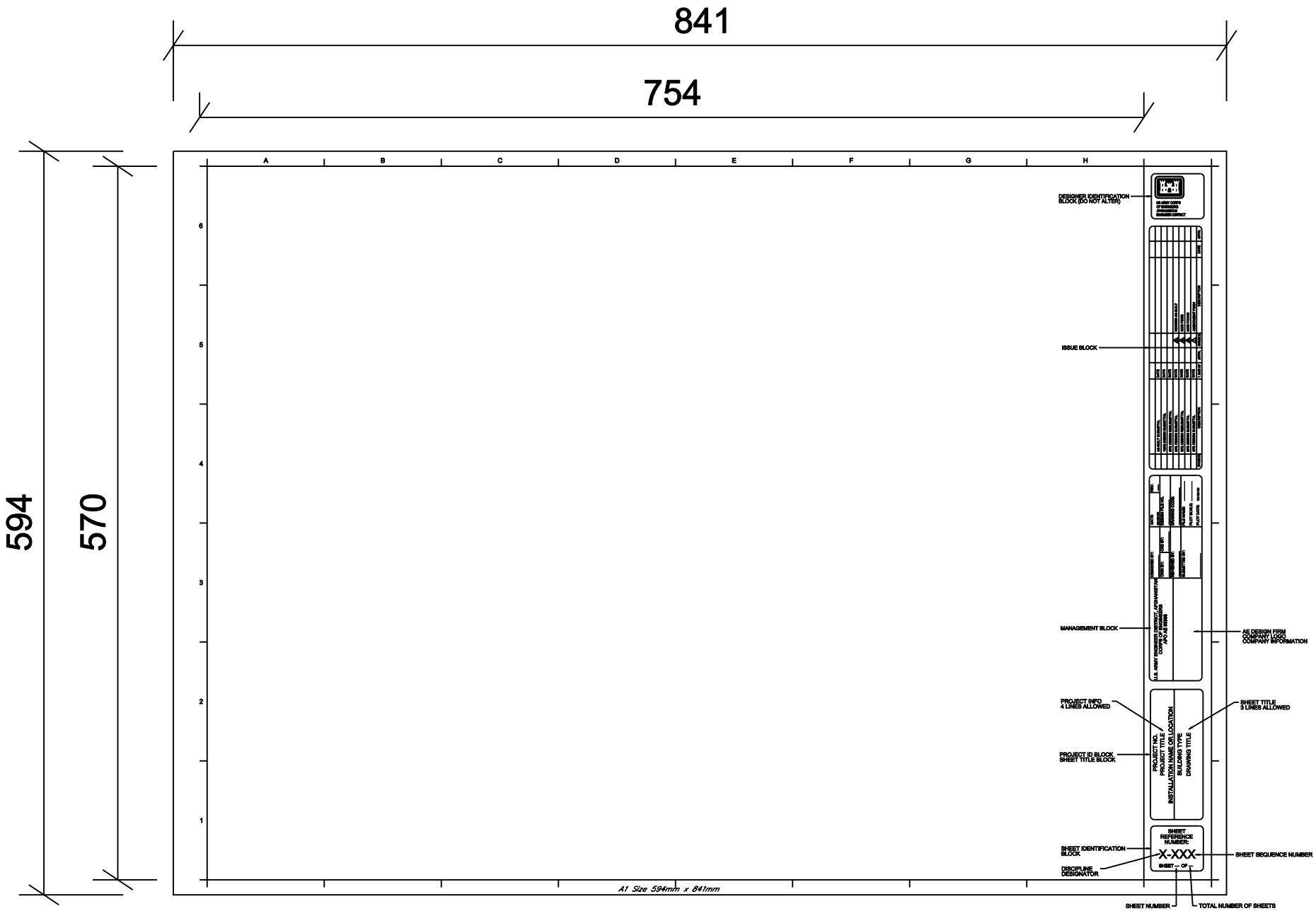


FIGURE 4 - BORDER SHEET SIZE

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR ☐ FIO ☐ GOV'T. APPROVAL

ITEM NO. *a.*	DESCRIPTION OF ITEM SUBMITTED *(Type size, model number/etc.)* *b.*	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. *(See instruction no. 8)* *c.*	NO. OF COPIES *d.*	CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO. *e.*	CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO. *f.*	FOR CONTRACTOR USE CODE *g.*	VARIATION *(See instruction No. 6)* *h.*	FOR CE USE CODE *i.*

REMARKS	**I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated.** _____ NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.

4. Submittals requiring expeditious handling will be submitted on a separate form.

5. Separate transmittal form will be used for submittals under separate sections of the specifications.

6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.

9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A	--	Approved as submitted.	E	--	Disapproved (See attached).
B	--	Approved, except as noted on drawings.	F	--	Receipt acknowledged.
C	--	Approved, except as noted on drawings. Refer to attached sheet resubmission required.	FX	--	Receipt acknowledged, does not comply as noted with contract requirements.
D	--	Will be returned by separate correspondence.	G	--	Other *(Specify)*

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG Form 4025-R)

SUBMITTAL REGISTER

(ER 415 1-10)

CONTRACT NO.

TITLE AND LOCATION

CONTRACTOR

SPECIFICATION SECTION

ACTIVITY NO a.	TRANS-MITTAL NO. b.	ITEM NO c.	SPECIFICATION PARAGRAPH NUMBER d.	DESCRIPTION OF ITEM SUBMITTED e.	TYPE OF SUBMITTAL: DATA f.	DRAWINGS g.	INSTRUCTIONS h.	SCHEDULES i.	STATEMENTS j.	REPORTS k.	CERTIFICATES l.	SAMPLES m.	RECORDS n.	CLASSIFICATION: INFORMATION ONLY o.	GOVERNMENT APPROVED p.	REVIEWER q.	CONTRACTOR SCHEDULE DATES: SUBMIT r.	APPROVAL NEEDED BY s.	MATERIAL NEEDED BY t.	CONTRACTOR ACTION: CODE u.	DATE v.	SUBMIT TO GOVERN-MENT w.	GOVERNMENT ACTION: CODE x.	DATE y.	REMARKS z.

ENG FORM 4288-R, MAR 95 EDITION OF SEP 93 IS OBSOLETE. PAGE 1 OF ____ PAGES (Proponent: CEMP-CE)

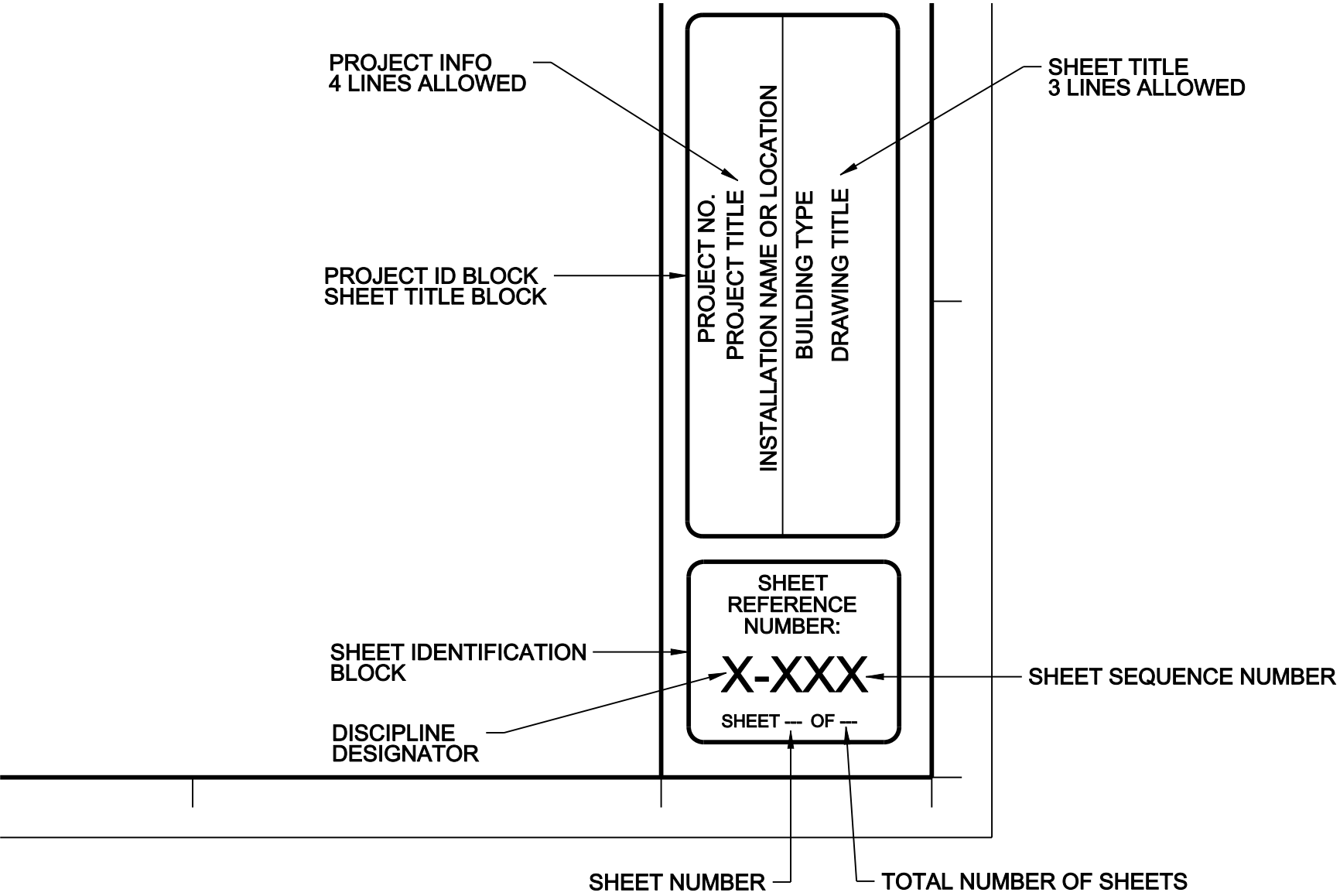


FIGURE 1 - AED TITLE BLOCK

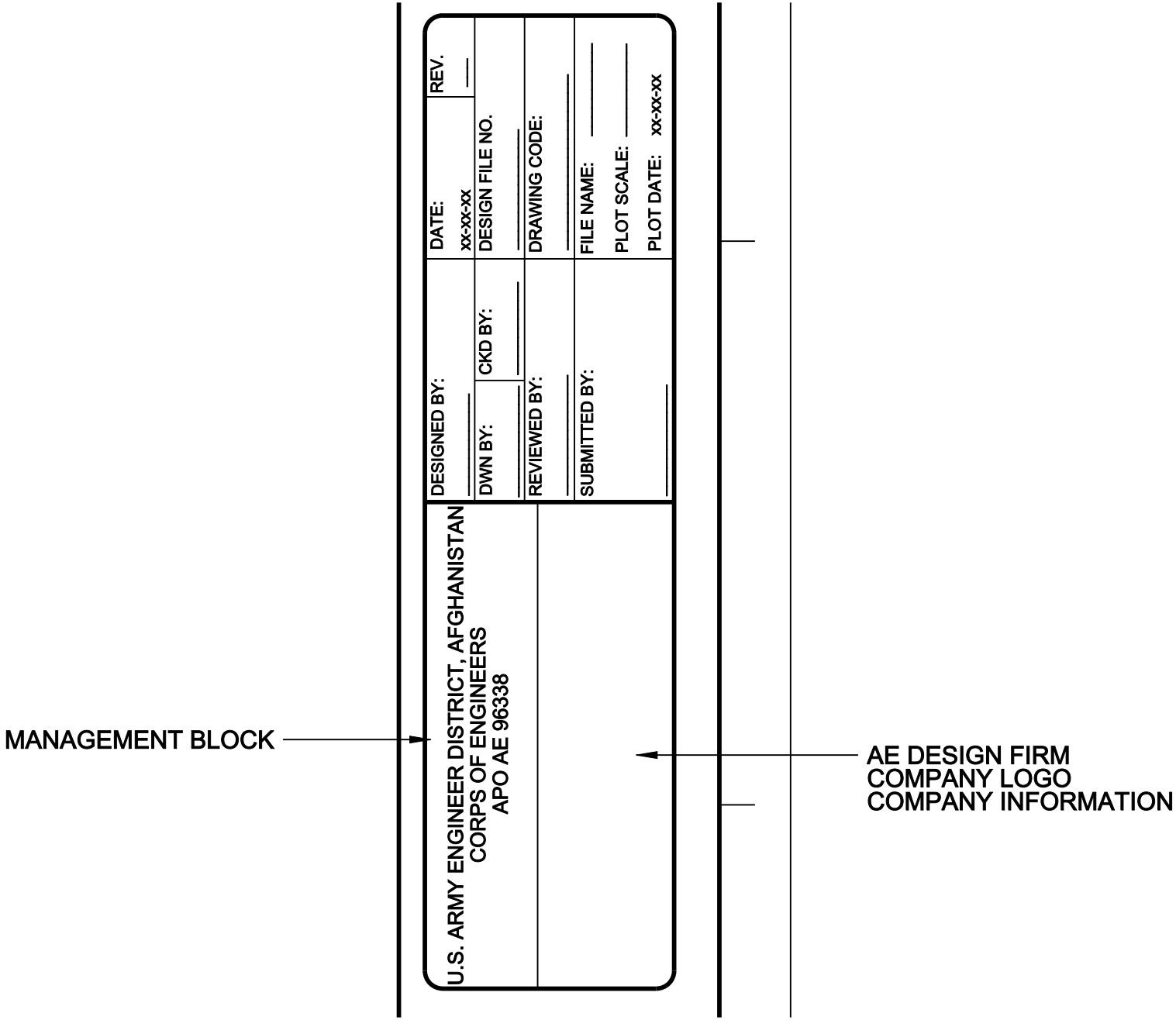


FIGURE 2 - AED MANAGEMENT BLOCK

H

DESIGNER IDENTIFICATION BLOCK (DO NOT ALTER)

US ARMY CORPS
OF ENGINEERS
AFGHANISTAN
ENGINEER DISTRICT

ISSUE BLOCK

SYMBOL	DESCRIPTION	DATE	APPR.	SYMBOL	DESCRIPTION	DATE	APPR.
	AS-BUILT SUBMITTAL	DATE					
	100% DESIGN SUBMITTAL	DATE					
	99% DESIGN RESUBMITTAL	DATE					
	99% DESIGN SUBMITTAL	DATE		4	REVISED AS-BUILT		
	65% DESIGN RESUBMITTAL	DATE		3	MOD P0003		
	65% DESIGN SUBMITTAL	DATE		2	MOD POOO2		
	35% DESIGN SUBMITTAL	DATE		1	AMENDMENT P0001		
		1 AUG 07					

FIGURE 3 - AED ISSUE BLOCK
& REQUIRED NOTATIONS

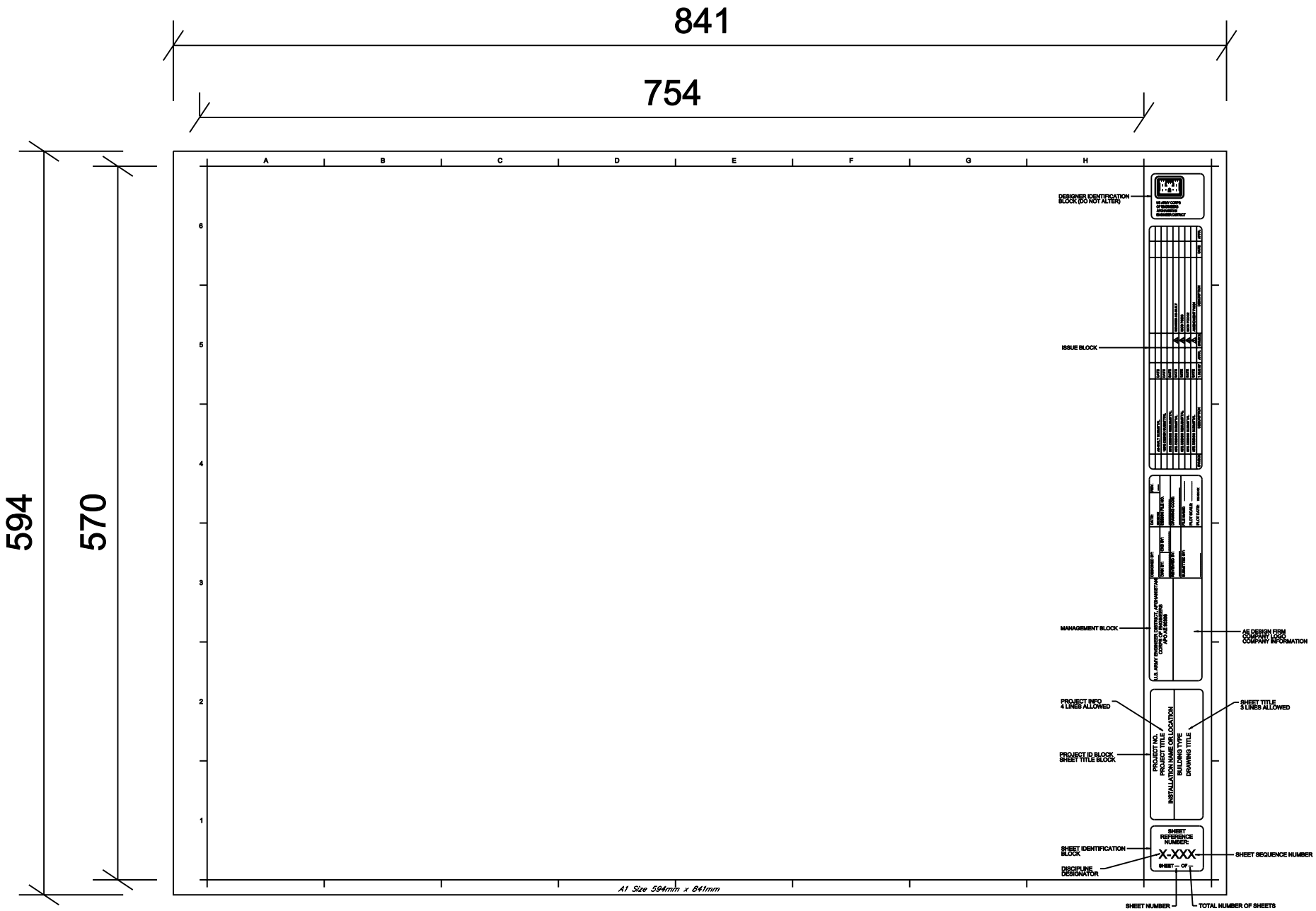
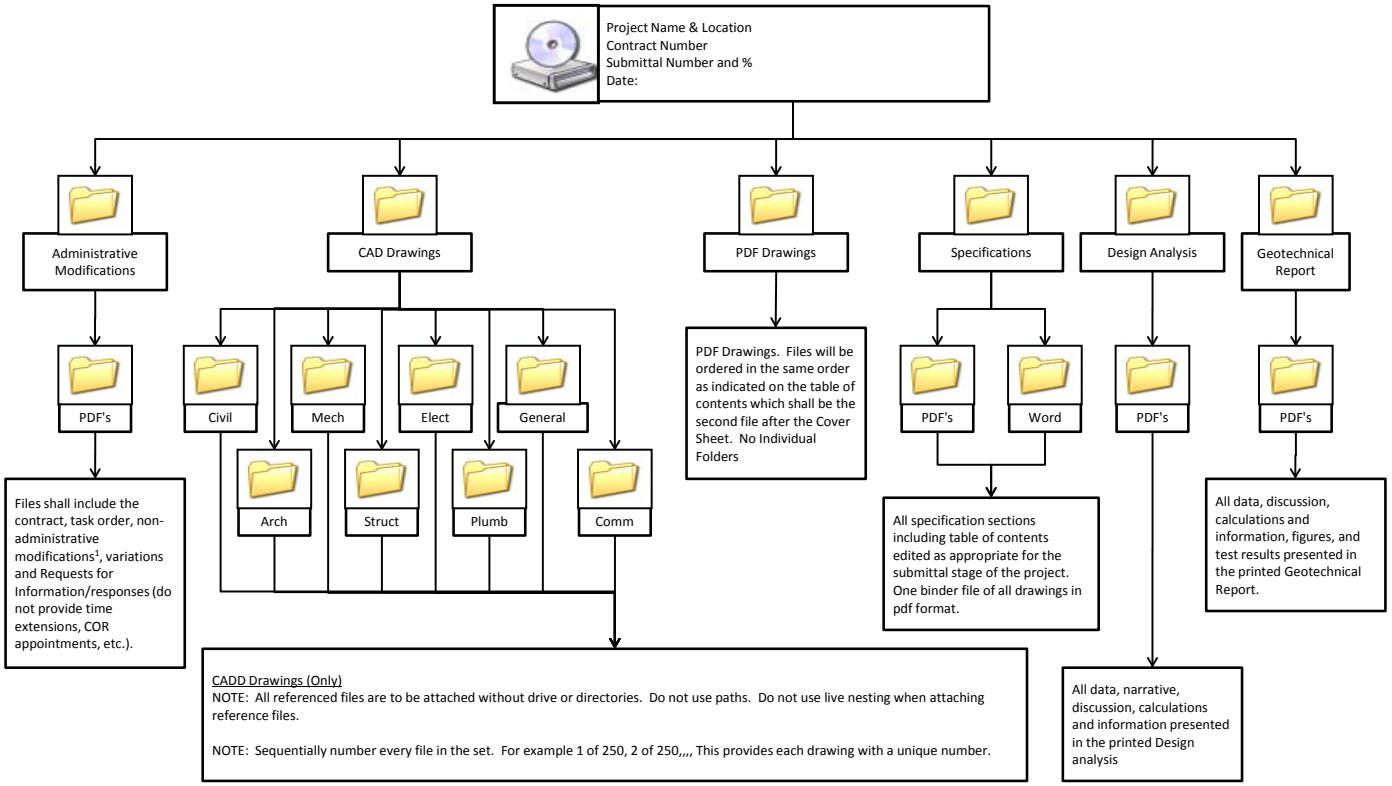


FIGURE 4 - BORDER SHEET SIZE

Up Provincial Response Company
Maydan Shahr Wardak



SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL: 01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Classification: Information Only	Government Approved	Reviewing Office: DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Contractor Scheduled Dates: Submit	Approval Needed By	Material Needed By	Contr Actions: Action Code	Date of Action	Govt Actions: Action Code	Date of Action	Remarks
		01010	1.4	Construction Quality Management Course	X												X			X										
		01010	3.1	Demining Plan (if required)	X												X	X												
		01010	3.1	Demining Certificate	X												X	X												
		01010	1.6	Electrician Qualifications							X						X			X										
		01010	1.7	Plumbing Qualifications							X						X			X										
		01010	1.8	Sheetmetal Worker Qualifications							X						X			X										
		01010	2	Right of Entry Coordinate Data	X												X	X												
		01040	3.1	Securtiy Plan	X												X			X										
		01060	1.2	Area Use Plan	X												X			X										
		01335	1.2.1.1	Preliminary Design Reports - 10%					X								X	X												
		01335	1.2.1.2	Site-Adapt General Design Review - 65%					X								X	X												
		01335	1.2.1.3	Final Site-Adapt Design Review - 90%					X								X	X												
		01335	1.2.1.4	Cleared For Construction Review - 100%					X								X	X												
		01321	1.1	Initial Schedule	X												X			X										
		01355	1.7	Environmental Protection Plan	X												X			X										
		01451	2.3	Quality Control Plan Design	X												X			X										
		01451	2.3	Quality Control Plan Construction	X												X			X										
		01525	1.2	Accident Prevention Plan	X												X	X												
		01525	1.2	Activity Hazard Analysis	X												X			X										
		01525	1.2	Confined Space Entry Permit (If Needed)							X						X	X												
		01770	1.2.2	Hardware Schedule											X		X	X												
		01770	1.2.2	Final Architectural O&M Manuals											X		X	X												
		01770	1.2.2	Final Fire Detection & Alarm O&M Manuals											X		X	X												
		01770	1.2.2	Final Mechanical Systems O&M Manuals											X		X	X												
		01770	1.2.2	Generator O&M Manuals											X		X	X												
		01770	1.2.2	Diesel Fuel Tank and Fuel Pump O&M Manuals																										
		01770	1.2.2	Wood Windows O&M Manuals											X		X	X												
		01770	1.2.2	Final Electrical Systems O&M Manuals											X		X	X												
		01770	1.2.2	Submersible and Hand Pumping Units O&M Manuals											X		X	X												
		01770	1.2.2	Chlorine-Feeding Machine O&M Manual											X		X	X												
		01770	1.2.2	Propane Stove O&M Manuals											X		X	X												
		01770	1.2.2	Key Bitting											X		X	X												

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		01770	1.5	Training Plan											X		X	X												
		01770	1.7	Spare Parts											X		X	X												
		01780	1.2.1	As-Built Drawings											X		X	X												
		01780	1.2.2	As-Built Record of Equipment and Materials											X		X	X												
		01780	1.3	Warranty Management Plan											X		X	X												
		01780	1.3.4	Warranty Tags											X		X	X												
		01780	1.5	Final Cleaning											X		X	X												
		02 41 00	1.2	Demolition Plan (if required)	X												X			X										
		03 30 00	1.2	Concrete Mix Design					X							X				X										
		03 30 00	1.2	Portland Cement			X									X				X										
		03 30 00	1.2	Ready-Mix Concret			X									X				X										
		03 30 00	1.2	Concrete Aggregates			X									X				X										
		03 30 00	1.2	Reinforcing and Joint Materials			X									X				X										
		03 30 00	1.2	Concrete Curing Materials (if required)			X									X				X										
		03 30 00	1.2	Portland Cement			X									X				X										
		03 30 00	1.2	Concrete Mix Design Mill Certificates							X					X				X										
		03 30 00	1.2	Concrete Aggregates Mill Certificates							X					X				X										
		03 30 00	1.2	Admixtures								X				X				X										
		04 20 00	1.2	Structural Masonry Shop Drawings		X											X	X												
		04 20 00	1.2	Cold Weather Installation			X										X	X												
		04 20 00	1.2	Concrete Masonry Units (CMU)				X								X				X										
		04 20 00	1.2	Expansion Joint Materials				X								X				X										
		04 20 00	1.2	Pre-Mixed Mortar					X								X			X										
		04 20 00	1.2	Concrete Masonry Units (CMU)							X					X				X										
		04 20 00	1.2	Control Joint Keys							X					X				X										
		04 20 00	1.2	Anchors, Ties, and Bar Positioners							X					X				X										
		04 20 00	1.2	Expansion Joint Materials							X					X				X										
		04 20 00	1.2	Reinforcing Steel Bars and Rods							X					X				X										
		04 20 00	1.2	Masonry Cement							X					X				X										
		04 20 00	1.2	Admixtures for Masonry Mortar and/or Grout							X					X				X										
		04 20 00	1.2	Masonry Cement								X				X				X										
		04 43 00	1.2	Stone Masonry Shop Drawings		X											X	X												
		04 43 00	1.2	Cold Weather Installation			X										X	X												
		04 43 00	1.2	Stone				X								X				X										
		04 43 00	1.2	Anchors, Ties, and Bar Positioners				X								X				X										
		04 43 00	1.2	Anchors, Ties, and Bar Positioners							X					X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		04 43 00	1.2	Expansion Joint Materials							X					X				X										
		04 43 00	1.2	Reinforcing Steel Bars and Rods							X					X				X										
		04 43 00	1.2	Masonry Cement							X					X				X										
		04 43 00	1.2	Admixtures for Masonry Mortar and/or Grout							X					X				X										
		04 57 13	1.2	Wood Stove Shop Drawings		X											X	X												
		05 12 00	1.4	Structural Steel Erection Plan		X											X	X												
		05 12 00	1.4	Structural Steel Fabrication Drawings		X											X	X												
		05 12 00	1.4	Shop Primer			X									X				X										
		05 12 00	1.4	Welding Electrodes and Rods			X										X			X										
		05 12 00	1.4	Non-Shrink Grout			X									X				X										
		05 12 00	1.4	Class B Coating						X						X				X										
		05 12 00	1.4	Bolts, Nuts, and Washers						X						X				X										
		05 12 00	1.4	Steel Certifications							X					X				X										
		05 12 00	1.4	Bolts, Nuts, and Washers Certifications							X					X				X										
		05 12 00	1.4	Galvanizing							X					X				X										
		05 12 00	1.4	AISC Quality Certification							X					X				X										
		05 12 00	1.4	Welding Procedures and Qualifications							X						X			X										
		05 40 00	1.2	Framing Components		X											X	X												
		05 40 00	1.2	Steel Studs, Joists, Tracks, Bracing, Bridging & Acces.			X									X				X										
		05 40 00	1.2	Metal Framing Calculations					X								X	X												
		05 40 00	1.2	Load Bearing Cold-Formed Metal Framiing							X					X				X										
		05 40 00	1.2	Weld Certifications							X					X				X										
		05 50 00	1.2	Structural Steel Door Frames Fabrication Drawings		X										X				X										
		05 50 00	1.2	Access Doors and Panels Installation Drawings		X										X				X										
		05 50 00	1.2	Cover Plates and Frames Installation Drawings		X										X				X										
		05 50 00	1.2	Floor Gratings, Exterior Stair Trends and Landings		X										X				X										
		05 50 00	1.2	Handrails, Ladders		X											X			X										
		05 50 00	1.2	Embedded Angles and Plates Installation Drawings		X										X				X										
		05 50 00	1.2	Metal Window Sills Installation Drawings		X										X				X										
		05 50 00	1.2	Steel Corner Guards Installation Drawings		X										X				X										
		05 50 00	1.2	Stainless Steel Back Splash Installation Drawings		X										X				X										
		05 50 00	1.2	Access Doors and Panels			X									X				X										
		05 50 00	1.2	Cover Plates and Frames			X									X				X										
		05 50 00	1.2	Control Joint Covers			X									X				X										
		05 50 00	1.2	Expansion Joint Covers			X									X				X										
		05 50 00	1.2	Handrails, Ladders, Steel Stairs			X									X				X										
		05 50 00	1.2	Window Sub Sill			X									X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		05 50 00	1.2	Cast Iron Plate for Wood Stove Top			X									X				X										
		05 50 00	1.2	Cast iron Grid Plate for Wood Stove Fire Box			X									X				X										
		05 50 00	1.2	Cast Iron Insert for Wood Stove			X									X				X										
		05 50 00	1.2	Cast Iron Hinged Cleanout Door for Wood Stove			X									X				X										
		05 50 00	1.2	Cast Iron Sliding Fire Box Door for Wood Stove			X									X				X										
		05 50 00	1.2	Structural Steel Door Frames			X									X				X										
		05 50 00	1.2	Window and Door Guards			X									X				X										
		05 50 00	1.2	Roof and Floor Hatch			X									X				X										
		05 50 00	1.2	Steel Corner Guard			X									X				X										
		05 50 00	1.2	Stainless Steel Back Splash			X									X				X										
		05 50 00	1.2	Expansion Joint Covers				X								X				X										
		05 50 00	1.2	Control Joint Covers				X								X				X										
		05 50 00	1.2	Steel Corner Guards				X								X				X										
		05 50 00	1.2	Stainless Steel Back Splash				X								X				X										
		06 10 00	1.2	Nailers and Nailing Strips		X										X				X										
		06 10 00	1.2	Adhesives			X									X				X										
		06 10 00	1.4	Certificates of Grade							X					X				X										
		07 13 53	1.2	Elastomeric Waterproofing Sheet Metal			X									X				X										
		07 13 53	1.2	Protection Board			X									X				X										
		07 13 53	2.1	Primers, Adhesives, and Mastics			X									X				X										
		07 13 53	1.2	Elastomeric Waterproofing Sheet Metal				X								X				X										
		07 13 53	1.2	Protection Board				X								X				X										
		07 13 53	2.1	Primers, Adhesives, and Mastics				X								X				X										
		07 13 53	2.1	Primers, Adhesives, and Mastics								X				X				X										
		07 21 13	1.2	Board Insulation			X										X			X										
		07 21 13	1.2	Vapor Retarder			X									X				X										
		07 21 13	1.2	Board Insulation			X									X				X										
		07 21 16	1.2	Blanket Insulation			X										X	X												
		07 21 16	1.2	Vapor Retarder			X									X				X										
		07 21 16	1.2	Pressure Sensitive Tape			X									X				X										
		07 21 16	1.2	Accessories			X									X				X										
		07 21 16	1.2	Insulation								X				X				X										
		07 41 13	1.3	Metal Roofing		X											X	X												
		07 41 13	1.3	Roof Panels			X									X				X										
		07 41 13	1.3	Accessories			X									X				X										
		07 41 13	1.3	Fasteners			X									X				X										
		07 41 13	1.3	Underlayments			X									X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

Solicitation No.

CONTRACTOR:

CONTRACT:

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		07 41 13	1.3	Gasket and Insulating Compounds			X									X				X										
		07 41 13	1.3	Roof Curbs			X									X				X										
		07 41 13	1.3	Roof Panels				X								X				X										
		07 41 13	1.3	Factory-Applied Color Finish Charts				X									X	X												
		07 41 13	1.3	Accessories				X								X				X										
		07 41 13	1.3	Fasteners				X								X				X										
		07 41 13	1.3	Sealant				X								X				X										
		07 41 13	1.3	Gasket and Insulating Compounds				X								X				X										
		07 41 13	1.3	Roof Curbs				X								X				X										
		07 41 13	1.3	Wind Uplift Resistance					X							X				X										
		07 41 13	1.3	Roof Assembly						X						X				X										
		07 41 13	1.3	Factory Color Finish Performance Requirements						X						X				X										
		07 41 13	1.3	Roof Panels							X					X				X										
		07 41 13	1.3	Self-Adhering Modified Bitumen Underlayment							X					X				X										
		07 41 13	1.3	Qualification of Manufacturer							X					X				X										
		07 41 13	1.3	Qualification of Applicator							X					X				X										
		07 41 13	1.3	Insulationi Installation Instructions								X				X				X										
		07 41 13	1.3	Metal Roof Panel Manufacturer Warranty											X		X	X												
		07 41 13	1.3	Manufacturer's Finish Warranty											X		X	X												
		07 41 13	1.3	Metal Roof System Installer Warranty											X		X	X												
		07 41 13	3.7	Information Card											X		X	X												
		07 60 00	1.3	Covering on Flat, Sloped, or Curved Surfaces		X										X				X										
		07 60 00	1.3	Gutters, Downspouts		X										X				X										
		07 60 00	1.3	Expansion Joints		X										X				X										
		07 60 00	1.3	Gravel Stops and Fascias		X										X				X										
		07 60 00	1.3	Splash Pans		X										X				X										
		07 60 00	1.3	Flashing for Roof Drains, Base Flashing, Counterflashing, F		X										X				X										
		07 60 00	1.3	Reglets, Scuppers, Copings, Drip Edge		X										X				X										
		07 60 00	1.3	Conductor Heads, Open Valley Flsshing, Eave Flashing		X										X				X										
		07 84 00	1.2	Firestopping Materials		X										X				X										
		07 84 00	1.2	Firestopping Materials							X					X				X										
		07 84 00	1.2	Firestopping Installer Qualifications							X					X				X										
		07 84 00	1.2	Firestopping Inspection						X						X				X										
		07 92 00	1.2	Sealants, Primers, Bond Breakers, Backstops			X									X				X										
		07 92 00	1.2	Sealants							X					X				X										
		08 11 13	1.2	Steel Doors and Frames		X											X	X												
		08 11 13	1.2	Accessories, Weatherstripping		X										X				X										
		08 11 13	1.2	Steel Doors and Frames Schedule					X							X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

Solicitation No.

CONTRACTOR:

CONTRACT:

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		08 11 13	1.2	Steel Doors and Frames			X									X				X										
		08 11 13	1.2	Accessories, Weatherstripping			X									X				X										
		08 11 13	1.2	Factory-Applied Enamel Finish				X								X				X										
		08 14 00	1.2	Wood Doors		X											X	X												
		08 14 00	1.2	Wood Doors, Frames, Accessories			X									X				X										
		08 14 00	1.2	Wood Doors				X								X				X										
		08 14 00	1.2	Wood Doors Finish Colors				X								X				X										
		08 34 63	1.2	Detention Hollow Metal Doors and Frames		X											X	X												
		08 34 63	1.2	Detention Hollow Metal Doors and Frames			X									X				X										
		08 34 63	1.2	Door Fabrication Test Reports						X						X				X										
		08 52 00	1.2	Wood Windows		X											X	X												
		08 52 00	1.2	Wood Windows								X				X				X										
		08 56 63	1.2	Window Units		X										X				X										
		08 56 63	1.2	Window Units, Fasteners, Accessories			X									X				X										
		08 71 00	1.2	Hardware Schedule, Keying System		X										X				X										
		08 71 00	1.2	Hardware Items			X									X				X										
		08 71 00	1.2	Hardware Installation								X				X				X										
		08 81 00	1.2	Glass Installation		X										X				X										
		08 81 00	1.2	Glass			X										X	X												
		08 81 00	1.2	Plastic Glazing, Glazing Accessories			X									X				X										
		08 81 00	1.2	Plastic Sheet, Glazing Compound, Glazing Tape, Sealant			X									X				X										
		08 81 00	1.2	Plastic Glazing, Glazing Accessories							X					X				X										
		08 81 00	1.2	Setting and Sealing Materials								X				X				X										
		08 81 00	1.2	Plastic Glazing Setting								X				X				X										
		09 22 37.00 10	1.2	Lathing and Plastering Detail Drawings		X											X	X												
		09 22 37.00 10	1.2	Lathing Installation			X									X				X										
		09 22 37.00 10	1.2	Portland Cement Plaster				X								X				X										
		09 22 37.00 10	1.2	Qualifactions							X					X				X										
		09 24 23	1.2	Lath Shop Drawings		X										X				X										
		09 24 23	1.2	Portland Cement, Lime, Sand			X									X				X										
		09 24 23	1.2	Colored Stucco Finish Coat				X								X				X										
		09 24 23	1.2	Sample Panel				X								X				X										
		09 66 16	1.2	Terrazzo Tile Shop Drawings		X											X	X												
		09 66 16	1.2	Terrazzo Tile Product Data			X									X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

Solicitation No.

CONTRACTOR:

CONTRACT:

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL: 01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Classification: Information Only	Government Approved	Reviewing Office: DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Contractor Scheduled Dates: Submit	Approval Needed By	Material Needed By	Contr Actions: Action Code	Date of Action	Govt Actions: Action Code	Date of Action	Remarks
		09 66 16	1.2	Terrazzo Tile Sample				X								X				X										
		09 66 16	1.2	Terrazzo Tile Certificates							X					X				X										
		09 90 00	1.2	Piping Identification Shop Drawings		X										X				X										
		09 90 00	1.2	Coatings			X									X				X										
		09 90 00	1.2	Manufacturers Technical Data Sheets			X									X				X										
		09 90 00	1.2	Sealants			X									X				X										
		09 90 00	1.2	Color Samples				X								X				X										
		09 90 00	1.2	Applicators Qualifications							X					X				X										
		09 90 00	1.2	Qualification Testing							X					X				X										
		09 90 00	1.2	Mixing and Application Instructions								X				X				X										
		10 28 13	2.2	Finishes, Accessory Items			X									X				X										
		10 28 13	2.2	Finishes, Accessory Items				X								X				X										
		10 28 13	2.2	Accessory Items							X					X				X										
		10 35 13.13	1.1	Stove Wall Thimble				X								X				X										
		10 35 23.13	1.3	Propane Stove			X									X				X										
		10 35 23.13	1.3	Propane Stove								X				X				X										
		10 35 23.13	1.3	Exhaust Hood								X				X				X										
		10 35 23.13	1.3	5 year Warranty Propane Stove											X		X	X												
		10 44 16	1.2	Fire Extinguisher, Wall Brackets, Accessories		X										X				X										
		10 44 16	1.2	Fire Extinguisher, Wall Brackets, Accessories			X									X				X										
		10 44 16	1.2	Fire Extinguisher, Wall Brackets, Accessories				X								X				X										
		10 44 16	1.2	Warranty Tags											X		X	X												
		10 90 00.00.48	1.2	Clothesline Structure Shop Drawings		X										X				X										
		10 90 00.00.48	1.2	Clothesline Structure			X									X				X										
		12 30 00.00.40	1.2	Steel and Wood Cabinets Fabrication Drawings		X										X				X										
		12 30 00.00.40	1.2	Steel and Wood Cabinets Installation Drawings		X											X			X										
		12 30 00.00.40	1.2	Corrosion-Resistant Steel			X									X				X										
		12 30 00.00.40	1.2	Plywood, Hardwood, Glass			X									X				X										
		12 30 00.00.40	1.2	Adhesives, Filler Material, Varnish			X									X				X										
		12 30 00.00.40	1.2	Fasteners, Fixtures, Accessories, Hardware			X									X				X										
		12 30 00.00.40	1.2	Softwoods (If required)			X									X				X										
		12 30 00.00.40	1.2	Countertop, Backsplash				X								X				X										
		12 30 00.00.40	1.2	Acessories, Hardware				X								X				X										
		12 30 00.00.40	1.2	Manufacturer's Standard Color Charts				X								X				X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL: 01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Classification: Information Only	Government Approved	Reviewing Office: DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Contractor Scheduled Dates: Submit	Approval Needed By	Material Needed By	Contr Actions: Action Code	Date of Action	Govt Actions: Action Code	Date of Action	Remarks
		22 00 00	1.2	Plumbing System Shop Drawings		X										X				X											
		22 00 00	1.2	Water Closets			X									X				X											
		22 00 00	1.2	Faucets and Trim, All Locations			X									X				X											
		22 00 00	1.2	Utility Sinks			X									X				X											
		22 00 00	1.2	Water Heaters			X									X				X											
		22 00 00	1.2	Hose Bibs and Wall Hydrants			X									X				X											
		22 00 00	1.2	Shower Faucets			X									X				X											
		22 00 00	1.2	Valves			X									X				X											
		22 00 00	1.2	Drains and Cleanouts			X									X				X											
		22 00 00	1.2	Pipe Insulation			X									X				X											
		22 00 00	1.2	Propane Storage Tanks, Welding			X									X				X											
		22 00 00	1.2	Drainage and Vent System Test						X							X			X											
		22 00 00	1.2	Building Sewer Tests						X							X			X											
		22 00 00	1.2	Water Supply System Test (Disinfection)						X							X			X											
		22 00 00	1.2	Propane Gas Supply, Sleeve, and Vent System Test						X							X			X											
		22 00 00	3.1	Posted Instructions											X		X			X											
		22 07 19	1.3	Pipe Insulation Installation Drawings		X										X				X											
		22 07 19	1.3	Adhesives			X									X				X											
		22 07 19	1.3	Coatings			X									X				X											
		22 07 19	1.3	Insulating Cement			X									X				X											
		22 07 19	1.3	Insulation Materials			X									X				X											
		22 07 19	1.3	Jacketing			X									X				X											
		22 07 19	1.3	Tape			X									X				X											
		23 00 00	1.5	Air Supply, Distributions, Ventilation, and Exhaust System		X										X				X											
		23 00 00	1.5	Duct Connectors			X									X				X											
		23 00 00	1.5	Duct Access Doors			X									X				X											
		23 00 00	1.5	Manual Balancing Dampers			X									X				X											
		23 00 00	1.5	Registers and Grille			X									X				X											
		23 00 00	1.5	Louvers			X									X				X											
		23 00 00	1.5	Centrifugal Fans			X									X				X											
		23 00 00	1.5	Centrifugal Type Power Wall Ventilators			X									X				X											
		23 00 00	1.5	Centrifugal Type Power Roof Ventilators			X									X				X											
		23 00 00	1.5	Filtered Supply Fans			X									X				X											
		23 00 00	1.5	Electric Resistant Heater			X									X				X											
		23 00 00	1.5	Kitchen Hoods			X									X				X											
		23 00 00	1.5	Ceiling Fans			X									X				X											
		23 00 00	1.5	Wall Fans			X									X				X											
		23 00 00	1.5	Final Performance Tests						X							X			X											
		23 00 00	1.5	Damper Acceptance Test						X							X			X											

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL: 01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Classification: Information Only	Government Approved	Reviewing Office: DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Contractor Scheduled Dates: Submit	Approval Needed By	Material Needed By	Contr Actions: Action Code	Date of Action	Govt Actions: Action Code	Date of Action	Remarks
		26 05 48.00 10	1.2	Lighting Fixtures in Buildings		X										X				X											
		26 05 48.00 10	1.2	Lighting Fixtures in Buildings			X									X				X											
		26 05 48.00 10	1.2	Contractor Designed Bracing		X										X				X											
		26 20 00	1.3	Panelboards Shop Drawings		X											X	X													
		26 20 00	1.3	Wireways Drawings		X										X				X											
		26 20 00	1.3	Marking Strips Drawings		X										X				X											
		26 20 00	1.3	Receptacles and Circuit Breakers			X										X	X													
		26 20 00	1.3	Switches			X									X				X											
		26 20 00	1.3	Enclosed Circuit Breakers			X										X			X											
		26 20 00	1.3	Motor Controllers			X										X			X											
		26 20 00	1.3	Combination Motor Controllers			X										X			X											
		26 20 00	1.3	Manual Motor Starters			X										X			X											
		26 20 00	1.3	Telecommunications Grounding Busbar			X										X			X											
		26 20 00	1.3	Surge Protective Devices			X										X			X											
		26 20 00	1.3	600-volt Wiring Test						X							X	X													
		26 20 00	1.3	Ground System Test						X							X	X													
		26 20 00	1.3	Ground -Fault Receptacle Test						X							X	X													
		26 20 00	1.3	Fuses							X					X				X											
		26 28 01.00 10	1.2	Fault Current Analysis			X									X				X											
		26 28 01.00 10	1.2	Field Test Plan						X						X				X											
		26 28 01.00 10	1.2	Devices and Equipment							X					X				X											
		26 32 15.00 10	1.2	Detailed Drawings		X											X	X													
		26 32 15.00 10	1.2	Performance Criteria			X										X	X													
		26 32 15.00 10	1.2	Generator			X										X	X													
		26 32 15.00 10	1.2	On-Site Training			X										X	X													
		26 32 15.00 10	1.2	Generator Instructions								X					X	X													
		26 32 15.00 10	1.2	Factory and Inspection Tests						X							X	X													
		26 32 15.00 10	1.2	Final Acceptance Performance Tests						X							X	X													
		26 32 15.00 10	1.2	Posted Data and Instructions											X		X	X													
		26 41 00.00 20	1.3	Overall Lightning Protection System		X											X	X													
		26 41 00.00 20	1.3	Grounding System Test						X							X	X													
		26 41 00.00 20	1.3	Lightning Protection System Inspection						X						X				X											
		26 41 00.00 20	1.3	UL Listing or Label							X					X				X											
		26 51 00	1.4	Fluorescent Lighting Fixtures			X									X				X											
		26 51 00	1.4	Fluorescent Electronic Ballasts			X									X				X											

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		26 51 00	1.4	Fluorescent Lamps			X									X				X										
		26 51 00	1.4	Incandescent Lighting Fixtures			X									X				X										
		26 51 00	1.4	Exit Signs			X									X				X										
		26 51 00	1.4	Emergency Lighting Equipment			X									X				X										
		26 51 00	1.4	Lighting Fixtures				X								X				X										
		26 51 00	1.4	Operating Tests						X						X				X										
		26 51 00	1.4	Lighting Control System										X			X	X												
		26 56 00	1.3	Luminaire Drawings, Poles		X										X				X										
		26 56 00	1.3	Luminaires			X									X				X										
		26 56 00	1.3	Lamps, Ballasts			X									X				X										
		26 56 00	1.3	Time Switch, Photocell Switch			X									X				X										
		26 56 00	1.3	Luminaires				X								X				X										
		28 31 64.00 10	1.2	Fire Detection and Alarm System		X											X			X										
		28 31 64.00 10	1.2	Storage Batteries			X									X				X										
		28 31 64.00 10	1.2	Low Battery Voltage			X									X				X										
		28 31 64.00 10	1.2	Special Tools and Spare Parts			X									X				X										
		28 31 64.00 10	1.2	Technical Data and Computer Software			X										X			X										
		28 31 64.00 10	1.2	Training Plan								X				X				X										
		28 31 64.00 10	1.2	Final Acceptance Test Reports						X							X			X										
		28 31 64.00 10	1.2	Equipment Certificates							X					X				X										
		28 31 64.00 10	1.2	Installer Qualifications							X					X				X										
		31 05 19	1.2	Thread			X									X				X										
		31 05 19	1.2	Manufacturing Quality Control Sampling and Testing			X									X				X										
		31 05 19	1.2	Quality Assurance Samples and Tests				X								X				X										
		31 05 19	1.2	Geotextile Certificates			X									X				X										
		32 11 16	1.2	Aggregate Base Course			X									X				X										
		32 15 00	1.2	Aggregate Surface Course			X									X				X										
		32 31 00.00 10	1.2	Chain Link Fence						X						X				X										
		32 31 00.00 10	1.2	Barbed Wire						X						X				X										
		32 31 00.00 10	1.2	Barbed (Razor) Type Concertina Wire						X						X				X										
		33 11 00	1.4	Piping Materials			X									X				X										
		33 11 00	1.4	Valve Boxes			X									X				X										
		33 11 00	1.4	Design Calculations of Water Piping					X							X				X										
		33 11 00	1.4	Bacteriological Disinfection						X							X			X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		33 16 15	1.4	Water Storage Tank Installation		X										X				X										
		33 16 15	1.4	Tank, Controls and Instrumentation, Valves, Piping			X									X				X										
		33 16 15	1.4	Tank Coating Test Reports						X							X			X										
		33 16 15	1.4	Tank Testing and Balancing						X							X			X										
		33 20 00	1.4	Water Well Installation Diagrams		X											X	X												
		33 20 00	1.4	Water Well Installation Plan			X										X	X												
		33 20 00	1.4	Well Materials			X										X	X												
		33 20 00	1.4	Qualifications							X						X	X												
		33 20 00	1.4	Site Conditions			X										X	X												
		33 20 00	1.4	Geophysical Logging			X										X	X												
		33 20 00	1.4	Survey Maps and Notes						X							X	X												
		33 20 00	1.4	Well Development Records						X							X	X												
		33 20 00	1.4	Geophysical Logs						X							X	X												
		33 20 00	1.4	Decommissioning/Abandonment Records						X						X				X										
		33 20 00	1.4	Project Photographs						X						X				X										
		33 20 00	1.4	Water Source						X						X				X										
		33 20 00	1.4	Filter Pack						X						X				X										
		33 30 00	1.4	Sanitary Sewer Drawings and Calculations		X										X				X										
		33 30 00	1.4	Metal Items, Frames, Covers, Gradings		X										X				X										
		33 30 00	1.4	Pipline Materials			X									X				X										
		33 30 00	1.4	Portland Cement			X									X				X										
		33 40 01	1.4	Storm Drainage Shop Drawings		X										X				X										
		33 40 01	1.4	Piping Materials			X									X				X										
		33 40 01	1.4	Pipe for Culverts and Storm Drains				X								X				X										
		33 56 10	1.3	Diesel Fuel Storage Tanks		X											X	X												
		33 56 10	1.3	Fuel Pumps		X										X				X										
		33 56 10	1.3	Pipe and Fittings			X										X			X										
		33 56 10	1.3	Fuel Pumps			X										X			X										
		33 56 10	1.3	Valves			X										X			X										
		33 56 10	1.3	Flexible Hose			X										X			X										
		33 56 10	1.3	Dielectric Unions			X										X			X										
		33 56 10	1.3	Strainers			X										X			X										
		33 56 10	1.3	Instruments			X										X			X										
		33 56 10	1.3	Secondary Containment System for Piping			X										X			X										
		33 56 10	1.3	Testing of Fuel Oil Tanks and Fuel Oil Pumps						X							X			X										
		33 56 10	1.3	Welding Procedure							X						X			X										
		33 56 10	1.3	Welding Qualifications							X						X			X										

SUBMITTAL REGISTER

TITLE AND LOCATION:

CONTRACTOR:

CONTRACT:

Solicitation No.

Activity No.	Transmittal No.	Section Number	Paragraph Number	Description of Submittal	TYPE OF SUBMITTAL											Classification		Reviewing Office					Contractor Scheduled Dates			Contr Actions		Govt Actions		Remarks
					01-PRECON SUBMITTALS	02-SHOP DRAWINGS	03-PRODUCT DATA	04-SAMPLES	05-DESIGN DATA	06-TEST REPORTS	07-CERTIFICATES	08-MFRS INSTRUCTIONS	09-MFRS FIELD REPORT	10-O&M DATA	11-CLOSEOUT SUBMITTALS	Information Only	Government Approved	DO-District Office	AO-Area Office	RO-Resident Office	PO-Project Office	AE-Architect /Engineer	Submit	Approval Needed By	Material Needed By	Action Code	Date of Action	Action Code	Date of Action	
		33 56 10	1.3	Flexible Hose							X						X			X										
		33 56 10	1.3	Dielectric Unions							X						X			X										
		33 56 10	1.3	Tank Surface Preparation							X						X			X										
		33 56 10	1.3	Coating Materials							X						X			X										
		33 56 10	1.3	Coating Applicatin Procedure							X						X			X										
		33 56 10	1.3	Secondary Containment System for Piping								X				X				X										
		33 56 10	1.3	Flexible Pipe								X				X				X										
		33 70 02.00 1	1.4	Electrical Distribution System Detail Drawings		X										X				X										
		33 70 02.00 1	1.4	Nameplates			X									X				X										
		33 70 02.00 1	1.4	Material and Equipment			X									X				X										
		33 70 02.00 1	1.4	Factory Tests						X							X			X										
		33 70 02.00 1	1.4	Low-Voltage Cable Test						X							X			X										
		33 70 02.00 1	1.4	Ground Resistance Test						X							X			X										
		33 70 02.00 1	1.4	Circuit Breaker Test						X							X			X										
		33 70 02.00 1	1.4	Operating Tests						X							X			X										
		34 71 13.19	1.2	Vehicle Barriers Shop Drawings		X										X				X										
		34 71 13.19	1.2	Vehicle Barriers		X										X				X										
		43 21 39	1.3	Submersible Water Pumps Installation		X											X			X										
		43 21 39	1.3	Submersible Pumping Units			X										X			X										
		43 21 39	1.3	Hand Pump Units		X											X			X										
		43 21 39	1.3	Controls and Instrumentation, Valves, and Piping		X											X			X										
		43 21 39	1.3	Spare Parts Data											X		X			X										
		43 21 39	1.3	Posted Instructions											X		X			X										
		43 21 39	1.3	Factory Submersible Pump Test						X							X			X										
		43 21 39	1.3	Testing, Adjusting, and Balancing						X							X			X										
		43 32 76	1.3	Chlorine Feeding Machines Installation		X										X				X										
		43 32 76	1.3	Material and Equipment			X										X			X										
		43 32 76	1.3	Final Test Report						X							X			X										
		43 32 76	1.3	Framed Instructions											X		X			X										

SECTION 01355

ENVIRONMENTAL PROTECTION (ANSF Version)

1 GENERAL

1.1 REFERENCES

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

ISLAMIC REPUBLIC OF AFGHANISTAN

Official Gazette No. 912 Environmental Law (2007)

U.S. DEPARTMENT OF DEFENSE (DoD)

DoD 4715.05-G Overseas Environmental Baseline Guidance Document (OEBGD) (2007)

U.S. ARMY (DA)

AR 200-1 Environmental Protection and Enhancement (2007)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 Safety and Health Requirements Manual (2009)

1.2 DEFINITIONS

1.2.1 ENVIRONMENTAL POLLUTION AND DAMAGE

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 ENVIRONMENTAL PROTECTION

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 CONTRACTOR GENERATED HAZARDOUS WASTE

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and fuel/oils/lubricants.

1.2.4 LAND APPLICATION FOR DISCHARGE WATER

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the waters of Afghanistan shall occur.

1.2.5 SURFACE DISCHARGE

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or waters of Afghanistan would require a permit to discharge water from the project.

1.2.6 HAZARDOUS MATERIAL (HM)

A useful product that requires special management because it has hazardous characteristics (ignitability, corrosivity, reactivity, or toxicity) that could pose dangers to human health or the environment. A HM becomes a Hazardous Waste when it can no longer be used for its intended purpose.

1.2.7 HAZARDOUS WASTE (HW)

A discarded material with properties that could pose dangers to human health or the environment. A HW either exhibits a hazardous characteristic or is specifically listed as a HW by the EPA or by the State.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. Environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable Afghanistan environmental laws and regulations. The Contractor shall be responsible for delays resulting from failure to comply with environmental laws and regulations.

For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural, and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, land, and includes management of visual esthetics, noise, solid waste, and erosion from stormwater, as well as pollutants.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by all subcontractors, suppliers, and vendors.

1.5 ABBREVIATIONS AND ACRONYMS

BACT	Best Available Control Technology
BMP	Best Management Practice
COR	Contracting Officer's Representative
ECO	Environmental Compliance Officer
HM	Hazardous Material HW Hazardous Waste
HW	Hazardous Waste
HWT	Hazardous Waste Technician
KO	Contracting Officer
PPE	Personal Protective Equipment
USACE	US Army Corps of Engineers

1.6 LAWS AND REGULATIONS

The Contractor shall comply with all applicable Afghanistan environmental, natural and cultural resources, and historic preservation laws and regulations.

1.7 SUBMITTALS

1.7.1 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental, natural and cultural resources, and historic preservation issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.7.1.1COMPLIANCE

No requirement in this Section shall be construed as relieving the Contractor of any applicable Afghanistan environmental, natural and cultural resources, and historic preservation protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting, for approval, any additional requirements to be included in the Environmental Protection Plan.

1.7.1.2CONTENTS

The environmental protection plan shall include, but shall not be limited to, the following:

1. Name(s) of the on-site Environmental Manager who is responsible for ensuring adherence to the Environmental Protection Plan and monitoring and documenting environmental procedures.
2. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are effective.
3. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.
4. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
5. Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a hazardous material. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

    a. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

b. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
c. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
d. The methods and procedures to be used for expeditious contaminant cleanup.

6. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.
7. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
8. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site and identifies the intended actions to prevent introduction of such materials into the air, water, or ground. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.
9. A hazardous waste plan that: identifies potentially hazardous waste that may be generated by the project.
10. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, decontamination water, hydrostatic test water, and water used in flushing of lines.
11. A historical, archaeological, cultural resources, and biological resources plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, and biological resources known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, and biological resources not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

1.8 PROTECTION FEATURES

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.10 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with environmental, natural and cultural resources, and historic preservation laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental, natural and cultural resources, and historic preservation permits and commitments required by Afghanistan environmental, natural and cultural resources, and historic preservation laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 WORK AREA LIMITS

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 LANDSCAPE

Trees, shrubs, vines, grasses, land forms and other landscape features indicated to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 EROSION AND SEDIMENT CONTROLS

The Contractor shall be responsible for providing erosion and sediment control measures. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality is not degraded as a result of the Contractor's construction activities. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps,

inlet and outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 CONTRACTOR FACILITIES AND WORK AREAS

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.2.5 TREE PROTECTION

All costs associated with tree protection requirements required by specifications and drawings are the full responsibility of the Contractor. The Contractor shall exercise care when excavating trenches in the vicinity of trees.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor.

3.3.1 COFFERDAMS, DIVERSIONS, AND DEWATERING OPERATIONS

Construction operations for dewatering, removal of cofferdams, and tailrace excavation shall be controlled at all times to maintain compliance designated uses of the surface water body.

3.3.2 STREAM CROSSINGS

Stream crossings (wet or dry) shall allow movement of materials or equipment without blocking the natural flow of water, if water became present.

3.4 AIR RESOURCES

3.4.1 PARTICULATES

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs.

3.4.2 ODORS

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard.

3.4.3 SOUND INTRUSIONS

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise.

3.4.4 Burning

All areas within facility perimeter fence line are designated as no burn areas.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

3.5.1 CHEMICALS AND CHEMICAL WASTES

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed at an appropriate disposal site.

3.5.2 CONTRACTOR HAZARDOUS MATERIAL / GENERATED HAZARDOUS WASTES / EXCESS HAZARDOUS MATERIALS

The Contractor shall, at a minimum, manage and store hazardous material and waste in an area designed and operated to provide appropriate segregation for different waste streams, including those that are chemically incompatible. Each area will have warning signs appropriate for the waste being accumulated at that site. Facilities or areas shall provide adequate ventilation, containment, and protection from the elements. Provide warning signs, limit access to the facility, and lock it when it is unattended. Contractor vehicles are not considered a proper storage facility. No HM or HW shall be stored in vehicles overnight or for any length of time. The Contractor shall take sufficient measures to prevent spillage or leakage of hazardous and toxic materials during dispensing or storage. The Contractor shall protect HM and HW from the weather by placing it in a safe covered location. The Contractor shall be responsible for storage, describing, packaging, labeling, and marking hazardous waste and hazardous material. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility.

3.5.3 FUEL AND LUBRICANTS

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation.

3.5.4 WASTE WATER

Disposal of waste water shall be as specified below.

a. Waste water from construction activities shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off site, unless on-site disposal is approved by the Contracting Officers Representative.
b. Water generated from the flushing of lines after decontamination or decontamination in conjunction with hydrostatic testing or only hydrostatic testing shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator.

3.6 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden,

bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.7 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Afghanistan regulations.

3.8 MAINTENANCE OF POLLUTION CONTROL

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.9 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area restored to its original condition.

-- End of Section --

SECTION 01415

METRIC MEASUREMENTS

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 621	(1994; R 1999e1) Use of Metric (SI) Units in Building Design and Construction (Committee E-6 Supplement to E380)
ASTM SI 10	(2002) American National Standard for Use of the International System of Units (SI): The Modern Metric System

2. GENERAL

This project includes metric units of measurements. The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the11th CGPM in 1960. A number of circumstances require that both metric SI units and English inch-pound (I-P) units be included in a section of the specifications. When both metric and I-P measurements are included, the section may contain measurements for products that are manufactured to I-P dimensions and then expressed in mathematically converted metric value(soft metric) or, it may contain measurements for products that are manufactured to an industry recognized rounded metric (hard metric)dimensions but are allowed to be substituted by I-P products to comply with the law. Dual measurements are also included to indicate industry and/or Government standards, test values or other controlling factors, such as the code requirements where I-P values are needed for clarity or to trace back to the referenced standards, test values or codes.

3. USE OF MEASUREMENTS IN SPECIFICATIONS

Measurements in specifications shall be either in SI or I-P units as indicated, except for soft metric measurements or as otherwise authorized. When only SI or I-P measurements are specified for a product, the product shall be procured in the specified units (SI or I-P) unless otherwise authorized by the Contracting Officer. The Contractor shall be responsible for

all associated labor and materials when authorized to substitute one system of units for another and for the final assembly and performance of the specified work and/or products.

3.1 HARD METRIC

A hard metric measurement is indicated by an SI value with no expressed correlation to an I-P value. Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

3.2 SOFT METRIC

a. A soft metric measurement is indicated by an SI value which is a mathematical conversion of the I-P value shown in parentheses (e.g. 38.1 mm (1-1/2 inches)). Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other controlling factor. The I-P value shall govern while the metric measurement is provided for information.

b. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products. These measurements are indicated by a manufacturing hard metric product dimension followed by the substitute I-P equivalent value in parentheses (e.g., 190 x 190 x 390 mm (7-5/8 x 7-5/8 x 15-5/8inches)).

3.3 NEUTRAL

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

3.4 COORDINATION

Discrepancies, such as mismatches or product unavailability, arising from use of both metric and non-metric measurements and discrepancies between the measurements in the specifications and the measurements in the drawings shall be brought to the attention of the Contracting Officer for resolution.

3.5 RELATIONSHIP TO SUBMITTALS

Submittals for Government approval or for information only shall cover the SI or I-P products actually being furnished for the project. The Contractor shall submit the required drawings and calculations in the same units used in the contract documents describing the product or requirement unless otherwise instructed or approved. The Contractor shall use ASTM SI 10 and ASTM E 621 as the basis for establishing metric measurements required to be used in submittals.

-- END OF SECTION --

SPECIFICATION SECTION 01451

CONTRACTOR QUALITY CONTROL

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)

ER 1110-1-12 (1993)	Quality Management
EM 385-1-1	Safety and Health Requirements Manual

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. All associated costs are included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

PART 2 PRODUCTS (Not Applicable)

2. EXECUTION

2.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clauses and this specification section. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

2.2 CQM TRAINING REQUIREMENTS

Before construction begins, the Contractor’s Quality Control Manager is required to have completed the U.S. Army Corps of Engineers (USACE) Construction Quality Management (CQM) course, or equivalent. The Champion Technical Training Center (CTTC) in Jalalabad and Kabul, Afghanistan provides

a course that satisfies the requirement. Courses are offered at regular intervals. For enrollment and course information contact WWW.CTTC-AF.ORG. Alternative CQM courses, other than those mentioned above, must be approved by the Quality Assurance Branch.

The contractor's quality control plan, as defined in USACE Guide Specification 01451 (or 01 45 04.00 10), entitled "Contractor Quality Control", must include "The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function." For the QC Manager, qualifications must include a certificate demonstrating completion of an approved CQM course.

2.3 QUALITY CONTROL PLAN

The Contractor shall furnish for review by the Government, not later than five (5) days after receipt of Notice-to-Proceed (NTP) the proposed Contractor Quality Control (CQC) Plan. The plan shall identify personnel, procedures, control, instructions, records, and forms to be used.

2.3.1 CONTENT OF THE CQC PLAN

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both on site and off-site, including work by subcontractors, fabricators, suppliers and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, consultants, and purchasing agents. These procedures shall be in accordance with Specification 01335 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

2.3.2 ADDITIONAL REQUIREMENTS FOR DESIGN QUALITY CONTROL (DQC) PLAN

The following additional requirements apply to the Design Quality Control (DQC) plan:

(1) The Contractor shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, all documents shall be technically reviewed by competent, independent reviewers identified in the DQC Plan. The same element that produced the product shall not perform the independent technical review (ITR). The Contractor shall correct errors and deficiencies in the design documents prior to submitting them to the Government.

(2) The Contractor shall include the design schedule in the master project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This should be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. The schedule shall include review and correction periods associated with each item. This should be a forward planning as well as a project monitoring tool. The schedule reflects calendar days and not dates for each activity. If the schedule is changed, the Contractor shall submit a revised schedule reflecting the change within 7 calendar days. The Contractor shall include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. These completed checklists shall be submitted at each design phase as part of the project documentation. Example checklists can be found in ER 1110-1-12.

(3) The DQC Plan shall be implemented by an Design Quality Control Manager who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated. This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. The Contractor shall

notify the Contracting Officer, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

The Contracting Officer will notify the Contractor in writing of the acceptance of the DQC Plan. After acceptance, any changes proposed by the Contractor are subject to the acceptance of the Contracting Officer.

2.3.3 ACCEPTANCE OF PLAN

Acceptance of the Contractor’s plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

2.3.4 NOTIFICATION OF CHANGES

Notification of Changes. After acceptance of the QC plan, the Contractor shall notify the Contracting Officer in writing a minimum of seven calendar days prior to any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

2.4 COORDINATION MEETING

After the Pre-construction Conference, before start of construction, and prior to acceptance by the Government of the Quality Control Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor’s quality control system. The CQC Plan shall be submitted for review a minimum of 5 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both on-site and off-site work, and the interrelationship of Contractor’s Management and control with the Government’s Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures, which may require corrective action by the Contractor.

2.5 QUALITY CONTROL ORGANIZATION

2.5.1 PERSONNEL REQUIREMENTS

The requirements for the CQC organization are a CQC System Manager, and sufficient number of additional qualified personnel to ensure safety and contract compliance. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary

to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

2.5.2 CQC SYSTEM MANAGER

The Contractor shall identify an individual within his organization at the site of the work who shall be responsible for overall management of the CQC and have the authority to act in all CQC matters for the Contractor. The CQC system manager shall be a graduate engineer, graduate architect, or a graduate construction manager, with experience on construction projects similar in type to this contract OR a construction person with a minimum of ten (10) years in related work. The CQC System Manager shall be on the site at all times during construction and shall be employed by the Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager will be identified in the plan to serve in the event of the CQC system manager’s absence. The requirements for the alternate will be the same as for the designated CQC manager.

2.5.3 ADDITIONAL REQUIREMENT

In addition to the above experience and/or education requirements, the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is periodically offered by the government, and inquiries as to the next course offering may be directed to the local construction field office.

2.5.4 ORGANIZATIONAL CHANGES

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

2.6 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in the STR titled SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

2.7 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of the construction work as follows:

2.7.1 PREPARATORY PHASE.

This phase shall be performed prior to beginning work on each definable feature of work, after all required documents and materials are

approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards, in the English language unless specifically approved otherwise by the Contracting Officer, applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b. A review of the contract drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. A check to assure that provisions have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to verify that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. Reviews of the appropriate activity hazard analysis to ensure safety requirements are met.

h. Discussion of procedures for constructing the work including repetitive deficiencies, construction tolerances and workmanship standards for that feature of work.

i. A check to ensure that the Contracting Officer has accepted the portion of the plan for the work to be performed.

j. Discussion of the initial control phase.

k. The Government shall be notified at least 24 hours in advance of beginning any of the required action of the preparatory phase. This phase shall include a meeting conducted by the CQC system manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC system manager and attached to the daily QC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

2.7.2 INITIAL PHASE.

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of preliminary work to ensure that it is in compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verification of full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC system manager and attached to the daily QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work on-site, or any time acceptable specified quality standards are not being met.

2.7.3 FOLLOW-UP PHASE.

Daily checks shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted, and all noted deficiencies corrected, prior to the start of additional features of work that may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

2.7.4 ADDITIONAL PREPARATORY AND INITIAL PHASES

Additional preparatory and initial phases may be required by the Contracting Officer on the same definable features of work if the quality of on-going work is unacceptable; if there are changes in the applicable QC staff or in the on-site production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

2.8 TESTS

2.8.1 TESTING PROCEDURE

The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product that conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Costs incidental to the transportation of samples or materials shall be borne by the Contractor.

Testing includes operation and/or acceptance tests when specified. A list of tests to be performed shall be furnished as a part of the CQC plan. The list shall give the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the Quality Control report for the date taken. Specification paragraph/item reference, location where tests were taken, and the sequential control number identifying the test will be given. Actual test reports may be submitted later, if approved by the Contracting Officer, with a reference to the test number and date taken. An information copy of tests performed by an off-site or commercial test facility will be provided directly to the Contracting Officer. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of the test facility for this contract.

2.9 COMPLETION INSPECTION

2.9.1 PUNCH-OUT INSPECTION

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. A punch list of items which do not conform to the approved drawings and specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once

this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

2.9.2 PRE-FINAL INSPECTION

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

2.9.3 FINAL ACCEPTANCE INSPECTION

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

2.10 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within forty-eight (48) hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

2.11 SAMPLE FORMS

In accordance with Specification 01312 QUALITY CONTROL SYSTEM, the contractor shall use the forms produced by and printed from QCS. Samples of any forms required to meet the requirements of this section which are not produced by that system shall be included in the contractors Quality Control Plan.

2.12 NOTIFICATION OF NONCOMPLIANCE

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

-- END OF SECTION --

SECTION 01525

SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

1. GENERAL

For contractor safety on projects associated with this program, compliance with EM 385-1-1 safety requirements will be the long-term goal reached by growing a safety culture. This compliance will, by necessity, be achieved through a phased-in process. In the Commander's letter at the preface of the EM 385-1-1, he acknowledges that in OCONUS locations, strict compliance with the manual may not be possible – and through the hazard analysis process, safety measures can be developed to attain the same degree of safety.

This specification consists of two parts:

1) Sections 1.1 through 3.12.1, which are the standard safety specifications for work in Afghanistan District and;

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 A10.32	Personal Fall Protection - Safety Requirements for Construction and Demolition Operations
ANSI Z359.1(1992; R 1999)	Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
ASME B30.3(1996)	Construction Tower Cranes

ASME INTERNATIONAL (ASME)

ASME B30.22(2000)	Articulating Boom Cranes
ASME B30.5(2004)	Mobile and Locomotive Cranes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10(2002)	Portable Fire Extinguishers
NFPA 241(2000)	Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B(2003)	Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70(2005)	National Electrical Code
NFPA 70E(2004)	Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1(2008) Safety	Safety and Health Requirements

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

29 CFR 1910	Occupational Safety and Health Standards (OSHA)
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1919	Gear Certification
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.1 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 SR SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G, District Safety Office

Activity Hazard Analysis (AHA); G, District Safety Office

Crane Critical Lift Plan; G, District Safety Office

Proof of qualification for Crane Operators; G, District Safety Office

UXO/Demining Safety Work Plan; G, District Safety Office

SD-06 Test Reports

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

Accident Reports

Monthly Exposure Reports

Crane Reports

Regulatory Citations and Violations

SD-07 Certificates

Confined Space Entry Permit

Contractor Safety Self-Evaluation Checklist; G, District Safety Office

UXO/Demining Clearance Certificate; G, District Safety Office

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

Certification of UXO clearance. Where excavations are to be performed in areas known or suspected to contain explosives, unexploded munitions, or military ordnance, surface and subsurface clearance by qualified explosive ordnance disposal (EOD) personnel shall be accomplished prior to excavation work. Clearance certificates must be forwarded to the AED-N UXO QA Safety specialist, prior to the start of construction. If the site does not have an associated clearance certificate, the site will require an UXO/mine clearance conducted to meet the certification of UXO clearance requirements EM 385-1-1 section 25.A.01.m.

Before initiation of work at the job site, all Accident Prevention Plans, Demining plans, and any other safety related plans shall be reviewed by the AED-N Safety Office.

1.2 DEFINITIONS

a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

b. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

d. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, extensive knowledge, training and experience in the field of fall protection who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

e. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

f. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

1.3 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employee uses illegal drugs or consumes alcohol during work hours. Ensure there are no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine, or saliva specimens and test the injured and involved employees for the influence of drugs and alcohol. A copy of the test shall be made available to the Contracting Officer upon request.

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 PERSONNEL QUALIFICATIONS

1.5.1.1 SITE SAFETY AND HEALTH OFFICER (SSHO)

Site Safety and Health Officer (SSHO) shall be provided at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The Contractor Quality Control (QC) person can only be the SSHO on this project if approved by the Contracting Officer. The SSHO shall meet the following requirements: A minimum of 1 year safety work on similar projects; 30-hour OSHA construction safety class or equivalent within the last 3 years. SSHO must be fluent in English and the local language for communication with the GDA. Competent person training as needed.

1.5.1.2 COMPETENT PERSON FOR CONFINED SPACE ENTRY

Provide a competent person meeting the requirements of EM 385-1-1 who is assigned in writing by the Government Designated Authority (GDA) to assess confined spaces and who possesses demonstrated knowledge, skill and ability to:

a. Identify the structure, location, and designation of confined and permit-required confined spaces where work is done;

b. Calibrate and use testing equipment including but not limited to, oxygen indicators, combustible gas indicators, carbon monoxide indicators, and carbon dioxide indicators, and to interpret accurately the test results of that equipment;

c. Assess hazardous conditions including atmospheric hazards in confined space and adjacent spaces and specify the necessary protection and precautions to be taken;

d. Determine ventilation requirements for confined space entries and operations;

e. Assess hazards associated with hot work in confined and adjacent space and determine fire watch requirements; and,

f. Maintain records required.

1.5.1.3 CRANE OPERATORS

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

1.5.2 PERSONNEL DUTIES

1.5.2.1 SITE SAFETY AND HEALTH OFFICER (SSHO)/SUPERINTENDENT

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Safety inspection logs shall be attached to the Contractors' daily quality control report.

b. Conduct mishap investigations and complete required reports. Maintain an accident/injury log such as the OSHA Form 300 or host nation equivalent, and Daily Production reports for prime and sub-contractors.

c. Be on site at all times while work is being performed.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. A list of unresolved safety and health deficiencies shall be posted on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties will result in dismissal of the superintendent and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.5.3 MEETINGS

1.5.3.1 PRECONSTRUCTION CONFERENCE

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. The Contractor shall discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of

anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, a schedule for the preparation, submittal, review, and acceptance of AHAs shall be established to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Work shall not begin until there is an accepted APP.

d. The functions of a Preconstruction conference may take place at the Post-Award Kickoff meeting for Design Build Contracts.

1.5.3.2 SAFETY MEETINGS

Shall be conducted and documented as required by EM 385-1-1. Minutes showing contract title, signatures of attendees and a list of topics discussed shall be attached to the Contractors' daily quality control report.

1.6 TRAINING

1.6.1 NEW EMPLOYEE INDOCTRINATION

New employees (prime and sub-contractor) will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.6.2 PERIODIC TRAINING

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

1.6.3 TRAINING ON ACTIVITY HAZARD ANALYSIS (AHA)

Prior to beginning a new phase, training will be provided to all affected

1.7 ACCIDENT PREVENTION PLAN (APP)

The Contractor shall use a qualified person to prepare the written site-specific APP in both English and in the host nation language. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. An AED Minimum Basic Outline for Contractor APP Template is provided at the end of this section. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and shall address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and

the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer.

In addition to following the requirements defined by EM 385-1-1, the Contractor shall submit for approval as part of the APP a DBA Insurance Plan describing how the requirements in Technical Specification Section 01060 Special Contract Requirements paragraph 2.11 will be met including: (1 properly and promptly submitting a claim, (2) gathering contact information of workers and their family, (3) notification and follow-up on a claim's status, (4) reporting status to the Government in a timely manner, and (5) providing prompt payment to an injured worker, or the family of a deceased worker.

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

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

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any hazard become evident, stop work in the area, secure the area, and develop a plan to remove the hazard. Notify the Contracting Officer within 24 hours of discovery. In the interim, all necessary action shall be taken to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment.

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

The APP shall be continuously reviewed and amended, as necessary, throughout the life of the contract. Unusual or high-hazard activities not identified in the original APP shall be incorporated in the plan as they are discovered.

1.7.1 EM 385-1-1 CONTENTS

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

a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be. The duties of each position shall be specified.

b. Qualifications of competent and of qualified persons. As a minimum, competent persons shall be designated and qualifications submitted for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.

c. Confined Space Entry Plan. Develop a confined space entry plan in accordance with USACE EM 385-1-1, Section 34, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

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

(1) For lifts of personnel, the plan shall demonstrate compliance with the requirements of EM 385-1-1, Section 16.T.

(2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

e. Fall Protection and Prevention (FP&P) Plan. The plan shall be site specific and address all fall hazards in the work place and during different phases of construction. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m (6 feet). A qualified person for fall protection shall prepare and sign the plan. The plan shall include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Fall Protection and Prevention Plan shall be revised every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. The accepted Fall Protection and Prevention Plan shall be kept and maintained at the job site for the duration of the project. The Fall Protection and Prevention Plan shall be included in the Accident Prevention Plan (APP).

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

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

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

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

1.9 DISPLAY OF SAFETY INFORMATION

Within 1 calendar day after commencement of work, erect a safety bulletin board at the job site. The safety bulletin board shall include information and be maintained as required by EM 385-1-1, section 01.A.06.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project. Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. The Government has no responsibility to provide emergency medical treatment. Military medical clinics may provide emergency treatment for serious injuries; the contractor is responsible for coordination with the local military medical clinic prior to mobilization.

1.12 REPORTS

1.12.1 ACCIDENT REPORTS

For recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the USACE Accident Report Form 3394 and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

1.12.2 ACCIDENT NOTIFICATION

Notify the Contracting Officer as soon as practical, but not later than eight hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000. Information shall include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). For all Fatal accidents the contractor will preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Notification to DBA insurance provider per Section 01060 is required also within 8 hours.

1.12.3 MONTHLY EXPOSURE REPORTS

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of

employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.12.4 CRANE REPORTS

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

1.13 HOT WORK

Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Installation. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) six kilogram ABC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in fire fighting techniques and remain on-site for a minimum of 120 minutes after completion of the task or as specified on the hot work permit.

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

2. EXECUTION

2.1 CONSTRUCTION AND/OR OTHER WORK

Before initiation of work at the job site, an accident prevention plan, written by the Contractor for the specific work and hazards of the contract and implementing in detail the pertinent requirements of EM 385-1-1, will be reviewed and found acceptable by designated Government personnel. Specific requirements for development of the accident prevention plan are found in sections 01.A and Appendix A of EM 385-1-1.

Before beginning each activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or subcontractor is to perform the work, activity hazard analysis (AHA) shall be prepared by the Contractor performing the work activity. See paragraph 01.A.13 of EM 385-1-1.

The Contractor shall require subcontractors to submit their plan of operations showing methods they propose to use in accomplishing major phases of work.

The Contractor shall be prepared to discuss the plans in conferences convened by the Contracting Officer prior to starting work on each major phase of operation. Plans shall include all pertinent information such as layout of haul roads, access roads, storage areas, electrical distribution lines, methods of providing minimum exposure to overhead loads, and methods of access to work areas. The plan for accomplishing the initial work phase shall be submitted within 15 calendar days after award of the contract. Plans for subsequent major phases of work shall be submitted not later than 15 calendar days prior to initiation of work on each major phase.

All areas where construction, demolition, alteration, building, or similarly related activities take place, all workers shall have the following minimum personal protective clothing and equipment:

1. Short sleeve shirt.
2. Long trousers.
3. Steel-toed safety boots.
4. Hard hat.

2.1.1 FALLING OBJECT PROTECTION

All areas must be barricaded to safeguard employees. When working overhead, barricade the area below to prevent entry by unauthorized employees. Construction warning tape and signs shall be posted so they are clearly visible from all possible access points. When employees are working overhead all tools and equipment shall be secured so that they will not fall. When using guardrail as falling object protection, all openings shall be small enough to prevent passage of potential falling objects.

2.1.2 HAZARDOUS MATERIAL USE

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material. Any work or storage involving hazardous chemicals or materials must be done in a manner that will not expose Government or Contractor employees to any unsafe or unhealthful conditions. Adequate protective measures must be taken to prevent Government or Contractor employees from being exposed to any hazardous condition that could result from the work or storage. The Prime Contractor shall keep a complete inventory of hazardous materials brought onto the work-site. Approval by the Contracting Officer of protective measures and storage area is required prior to the start of the work.

2.1.3 HAZARDOUS MATERIAL EXCLUSIONS

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

2.1.4 UNFORESEEN HAZARDOUS MATERIAL

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

2.2 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

The Contractor shall establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. The program shall include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

2.2.1 TRAINING

The Contractor shall institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, the Contractor shall provide training for each employee who might be exposed to fall hazards. A competent person for fall protection shall provide the training. Training requirements shall be in accordance with USACE EM 385-1-1, section 21.B.

2.2.2 FALL PROTECTION EQUIPMENT

The Contractor shall enforce use of the fall protection equipment designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is on a surface1.8 m(6 feet) or more above lower levels. Fall protection systems such as guardrails, personnel fall arrest system, safety nets, etc., are required when working within 1.8m (6 feet) of any leading edge. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, Elevating Work Platforms/Scissors Lifts: Scissors lifts shall be equipped with standard guardrails. In addition to the guardrail provided, if the scissor lift is equipped with a manufactured anchorage, a restraint system shall be used in addition to guardrails. Lanyards used with the restraint system shall be sufficiently short to prohibit workers from climbing out of, or being ejected from, the platform.

2.2.2.1 PERSONAL FALL ARREST EQUIPMENT

Personal fall arrest equipment, systems, subsystems, and components shall meet ANSI Z359.1 or European Union equivalent. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

2.2.3 FALL PROTECTION FOR ROOFING WORK

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 1.8 m (6 feet) of an edge, on low-slope roofs, personnel shall be protected from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 1.8 m (6 feet) from an edge, warning lines shall be erected and installed in accordance with USACE EM 385-1-1.

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

2.2.4 EXISTING ANCHORAGE

Existing anchorages, to be used for attachment of personal fall arrest equipment, shall be certified (or re-certified) by a qualified person for fall protection in accordance with ANSI Z359.1 or European Union equivalent. Exiting horizontal lifeline anchorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

2.2.5 HORIZONTAL LIFELINES

Horizontal lifelines shall be designed, installed, certified and used under the supervision of a qualified person for fall protection as part of a complete fall arrest system which maintains a safety factor of 2.

2.2.6 GUARDRAILS AND SAFETY NETS

Guardrails and safety nets shall be designed, installed and used in accordance with EM 385-1-1 or Host Nation requirements, whichever is more stringent.

2.2.7 RESCUE AND EVACUATION PROCEDURES

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

2.3 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access to scaffold platforms greater than 6 m in height shall be accessed by use of a scaffold stair system. Vertical ladders commonly provided by scaffold system manufacturers shall not be used for accessing scaffold platforms greater than 6 m in height. The use of an adequate gate is required. Contractor shall ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached

to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Work platforms shall be placed on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

2.4 EQUIPMENT

2.4.1 MATERIAL HANDLING EQUIPMENT

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be trained/licensed in accordance with Host Nation requirements.

2.4.2 WEIGHT HANDLING EQUIPMENT

a. Cranes and derricks shall be equipped as specified in EM-385-1-1 section 16.

b. The Contractor shall notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.

c. The Contractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person. All testing shall be performed in accordance with the manufacturer's recommended procedures.

d. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of USACE EM 385-1-1 section 11.

f. Crane suspended personnel work platforms (baskets) shall not be used unless the Contractor proves to the satisfaction of the Contracting Officer that using any other access to the work location would provide a greater hazard to the workers or is impossible. Personnel shall not be lifted with a line hoist or friction crane.

g. Portable fire extinguishers shall be inspected, maintained, and recharged.

h. All employees shall be kept clear of loads about to be lifted and of suspended loads.

i. The Contractor shall use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations the contractor shall set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

2.5 EXCAVATIONS

The competent person for excavations performed as a result of contract work shall be on-site when excavation work is being performed, and shall inspect, and document the excavations daily prior to entry by workers. The competent person must evaluate all hazards, including atmospheric, that may be associated with the work, and shall have the resources necessary to correct hazards promptly. All excavations shall conform with the requirements of Section 25 of EM 385-1-1.

2.5.1 UTILITY LOCATIONS

Prior to any excavation, all underground utilities in the work area must be positively identified by the contractor utilizing a) a private utility locating service in addition to any station locating service, and/or b) a metal and/or cable-detecting device along the route of the excavation. All underground utilities discovered will be flagged a distance of one-half (1/2) meter on each side of the location, and any markings made during the utility investigation must be maintained throughout the contract.

Damage occurring to existing utilities, when the above procedures are not followed, will be repaired at the Contractor’s expense.

2.5.2 UTILITY LOCATION VERIFICATION

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 0.61 m (2 feet) of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 30.5 m (100 feet) if parallel within 1.5 m (5 feet) of the excavation.

2.5.3 SHORING SYSTEMS

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding shall have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

2.5.4 TRENCHING MACHINERY

Trenching machines with digging chain drives shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file at the project site.

2.6 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems shall be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

2.7 ELECTRICAL

2.7.1 CONDUCT OF ELECTRICAL WORK

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. Energized work may never be performed without prior authorization. An energized work permit shall be submitted to GDA for acceptance in acceptance in accordance with 385-1-1, Section 11.A02.c. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed

in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

2.7.2 PORTABLE EXTENSION CORDS

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered and protected from damage. All damaged extension cords shall be immediately removed from service. Portable extension cords shall meet the requirements of NFPA 70 or European Union equivalent.

2.8 WORK IN CONFINED SPACES

The Contractor shall comply with the requirements in Section 34 of USACE EM 385-1-1. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level. Ventilation shall conform with the requirements of Section 06.G of 385-1-1.

c. Ensure the use of rescue and retrieval devices in confined spaces greater than 1.5 m (5 feet) in depth. Conform to Section 34 of USACE EM 385-1-1.

d. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

e. Include training information for employees who will be involved as entrants and attendants for the work. Conform to Section 34 of USACE EM 385-1-1.

f. Daily Entry Permit. Post the permit in a conspicuous place close to the confined space entrance.

2.9 CRYSTALLINE SILICA

Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with USACE EM 385-1-1, Appendix

06.H. The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

2.10 DEMOLITION

2.10.1 DEMOLITION PLAN

The Contractor shall submit a written demolition plan for all demolition work to be carried on the site. In addition, the demolition plan shall be signed by a Professional Registered Engineer and meet the requirements of the Corps of Engineers Safety and Health Manual, EM 385-1-1, section 23. The demolition plan shall be submitted to the COR at least 1 week before the beginning of the work, including structural calculations for the demolition, if necessary. The demolition work shall not begin before the Contractor has received a written approval from the COR.

2.10.2 PROTECTION OF PERSONNEL

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workers remove debris or perform other work in the immediate area.

2.10.3 PROTECTION OF STRUCTURES

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the COR. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

Interior concrete or masonry walls shall be demolished from the top down unless a Registered Engineer can demonstrate that an alternate method poses no additional safety hazards

2.11 HOUSEKEEPING

2.11.1 CLEAN-UP

The Contractor shall be responsible for cleaning up. The Contractor shall require his personnel to keep the immediate work site clean of all dirt and debris resulting from work under this contract. Accumulated dirt and debris shall be hauled off and disposed of in accordance with local law and at least once a week by the Contractor. Additionally, all debris in work areas shall be cleaned up daily or more frequently if necessary. Construction debris may be temporarily located in an approved location, however garbage accumulation must be removed each day.

Stairwells used by the Contractor during execution of work shall be cleaned daily. Cloths, mops, and brushes containing combustible materials shall be disposed of or stored outside of the buildings in tight covered metal

containers. Paints and thinners shall not be poured into inlets of the interior or exterior sewage system. Paint, stains, and other residues on adjacent surfaces or fixtures caused by the Contractor shall be carefully removed and cleaned to original finish. Upon completion of the work, the Contractor shall remove all construction equipment, materials and debris resulting from the work. The entire work site and the area used by Contractor personnel shall be left clean.

-- END OF SECTION --

ATTACHMENT 01525a

AED NORTH ACCIDENT PREVENTION PLAN MINIMUM BASIC OUTLINE

AED NORTH ACCIDENT PREVENTION PLAN
MINIMUM BASIC OUTLINE

Instructions

A. The prime contractor will type-in the information called for or put a checkmark in the appropriate box or boxes. A checkmark will signify a) Prime's selection from a list of items, b) Prime agrees with the corresponding information, c) Prime agrees to follow the requirement(s) listed herein and those contained in EM 385-1-1 dated 15 September 2008, and d) Prime agrees to develop written plans based on the requirements listed herein when required by this accident prevention plan.

B. The plan must consist of the following 10 sections:

1. Signature Sheet 2. Background Information 3. Statement of Safety and Health Policy 4. Responsibilities and Lines of Authority 5. Subcontractors and Suppliers	6. Training 7. Safety and Health Inspections 8. Accident Reporting 9. Plans (Programs, Procedures) 10. Risk Management Processes (AHA – Activity Hazard Analysis)

C. In addition to completing each section listed above several sections require certain supporting documents (resumes, certificates of training, organization chart, specific plans (crane lift plan medical support plan, etc.). The supporting documents and plans must be attached / inserted in the appendices listed below.

Appendix	Title	Required Contents
A	Background Information	Area Map
B	Statement of Health Policy	Copy of signed company Safety Policy
C	Responsibilities and Lines of Authority	Resumes and Certificates of 30 hour Construction Safety Course for SSHO/Safety Manager
D	Responsibilities and Lines of Authority	1. Names / proof of competency / qualification (Resumes and certificates) for persons listed in Section 4.c.; 2. Organization Chart (with names) for Key Corporate and Project personnel; 3. Incentive Program.
E	Training	Trained Personnel Listing
F	Plans	Layout Plan
G	Plans	Emergency Response Plan
H	Plans	As Applicable
I	AHAs	AHA form for each feature of work

1. SIGNATURE SHEET

a. Plan preparer (Safety manager, site safety and health officer (SSHO), or quality control representative will fill this role)**.**

Name:	**Title:**
Phone no.:	**Date:**
Signature:	

b. Plan approval (Company owner or Company / corporate officer authorized to obligate the company)**.**

Name:	**Title:**
Phone no.:	**Date:**
Signature:	

c. Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, project manager or superintendent, project safety professional, project QC).

Name:	**Title:**
Phone no.:	**Date:**
Signature:	

2. BACKGROUND INFORMATION

Prime Contractor:
Project name:
Contractor:
Contract no.:

a. Project description and location. Prime contractor will provide a brief description of the project to include its location.

b. ☐ A map of the project site general location and site plan – Insert in Appendix A.

c. Phases of work / Definable Features of Work. (**Examples:** Grading, excavation, formwork & shoring, steel erection, etc). NOTE: Section 10 requires an AHA for each of these phases

3. STATEMENT OF SAFETY AND HEALTH POLICY

3. ☐ **STATEMENT OF SAFETY AND HEALTH POLICY. Provide a copy of the current corporate/company Safety and Health Policy Statement.** The policy should include a detailed commitment to providing a safe and healthful workplace for all employees. The Contractor's written safety program goals, objectives, and accident experience goals for this contract shall also be incorporated. The prime contractor and his subcontractor(s) and supplier(s), and visitor(s), will comply with the policies set forth in EM 385-1-1 'Safety and Health Requirements Manual' dated 15 September 2008. Attach a copy of Company's Safety Policy at Appendix B.

a. ☐ **Company goal.** Prime contractor will provide a safe and healthful worksite that is free from recognized or anticipated hazards that could cause serious injury or death. We will strive for a zero accident rate and demand zero tolerance for unsafe acts, the workers who perpetrate them, and persons in positions of leadership who condone such actions.

4. RESPONSIBILITIES AND LINES OF AUTHORITY

a. ☐ Resumes. Prime contractor will provide resumes and training certificates for all safety personnel at Appendix C. At a minimum, the SSHO will have completed the OSHA 30 hour training and have one year experience.

b. ☐ Accountability for personnel responsible for safety.

Company owner will:

- Accept responsibility and accountability for the safety program.
- Provide leadership and guidance to supervisory personnel for the acceptance, maintenance, and enforcement of the safety program.
- Provide the necessary resources to maintain a safe and healthful project site.
- Conduct or attend monthly supervisory safety meetings.

Company owner name/phone no.

Project manager (superintendent) will:

- Implement the safety and health program at the project site.
- Conduct periodic project site inspections to verify accident prevention plan (APP) and EM 385-1-1 compliance.
- Review and act upon site safety and health inspection reports.
- Prepare man-hour reports, if applicable.
- Have authority to make spot corrections or stop work for safety purposes.
- Conduct or attend monthly supervisory safety meetings.
- Generate and/or sign ENG Form 3394 when required.

Project manager name/phone no.

Safety manager will:

- Accept administrative and oversight responsibility for the project site safety program.
- Provide technical guidance and support to the project manager, SSHO, supervisors, and foremen on safety and health issues.
- Conduct periodic worksite visits to verify APP and EM 385-1-1 compliance.
- Prepare and/or approve Activity Hazard Analysis.
- Report observations and findings to the company owner.
- Purchase personal protective equipment (PPE) and safety supplies as necessary.
- Have authority to make spot corrections or stop work for safety purposes.
- Conduct or attend monthly supervisory safety meetings.
- Generate and/or sign ENG Form 3394 when required.

Safety manager name/phone no.

Site safety and health officer will:

- Be on site at all times when work is performed.
- Conduct frequent worksite inspections to verify APP and EM 385-1-1 compliance.
- Maintain deficiency tracking system.
- Conduct or supervise on-site safety training.
- Investigate accidents and incidents as necessary.
- Purchase PPE and safety supplies as necessary.
- Have authority to make spot corrections or stop work for safety purposes.
- Conduct weekly employee safety meetings and attend monthly supervisory safety meetings.
- Generate and/or sign ENG Form 3394 when required.

Site safety and health officer name/phone no.

Supervisors (foremen) will:

- Cover appropriate activity hazard analysis before work begins.
- Conduct periodic project site inspections to verify APP and EM 385-1-1 compliance.
- Assist SSHO with accident and incident investigations.
- Have authority to make spot corrections or stop work for safety purposes.
- Conduct daily safety meetings with specific work crews.
- Conduct weekly employee safety meetings and attend monthly supervisory safety meetings.
- Generate and/or sign ENG Form 3394.

Workers will:

- Wear required PPE for each task.
- Inspect electrical cords daily before use.
- Inspect in-use hand and power tools daily before work begins. Guards will NOT be removed from tools equipped with guards.
- Inspect in-use machinery and mechanized equipment daily before work begins.
- Maintain good housekeeping at the worksite.
- Report accidents and incidents immediately to supervisor.
- Have authority to make spot corrections or stop work for safety purposes.
- Attend employee safety meetings.

c. ☐ **Competent/Qualified Persons.**

- Provide the names and proof of competency/qualification of Competent/Qualified personnel. The District SOHO will review the qualifications for acceptance. Provide information at Appendix D.
- No work shall be performed unless the designated competent/qualified person is present on the job site.
- The Competent/Qualified person shall assist with the preparation of AHAs for their areas of expertise.

d. ☐ **Lines of authority.** Provide Prime contractor lines of authority chart at Appendix D.

e. ☐ **Incentive program.** Prime contractor will provide their incentive program, if any, at Appendix D.

f. ☐ **Check the box if prime contractor will provide his own non-compliance program. If not, prime will put a check mark in paragraph's g and h.**

g. ☐ **Worker non-compliance with safety requirements.** The commission of unsafe acts will not be tolerated at the project site. In the event this type behavior occurs the following disciplinary actions will be taken:

- **First offense.** The offending party will be verbally warned and asked to correct the unsafe act (mentoring will take place if necessary - action will be noted in the daily report).
- **Second offense.** The offending party will be issued a written reprimand (action will be noted in the daily report).
- **Third offense.** The offending party will be removed from the worksite (action will be noted in the daily report).

h. ☐ **Supervisor non-compliance with safety requirements.** The condoning of unsafe acts at the worksite will not be tolerated. In the event this type behavior occurs the prime contractor will ensure disciplinary actions commensurate with the violation are taken.

5. SUBCONTRACTORS AND SUPPLIERS

a. ☐Check the box if there aren't any subcontractors or suppliers working the site.

b. Identification of subcontractors and suppliers. Prime contractor will list subcontractors and suppliers, if known, and their phone numbers.

Co:	**Ph:**
Co:	**Ph:**
Co:	**Ph:**
Co:	**Ph:**

c. ☐ Means for controlling subcontractors and suppliers. Prime contractor will meet with subcontractors and suppliers before work begins, and periodically thereafter, to coordinate activities and schedules, and to resolve any safety issues that may arise.

d. ☐ Subcontractor and supplier safety responsibilities. Subcontractors and suppliers will adhere to the requirements of the prime contractor's APP. Prime contractor will have subcontractors and suppliers sign the accident prevention plan signifying their understanding of, and compliance with, its provisions.

SUBCONTRACTOR AND SUPPLIER ACCEPTANCE OF ACCIDENT PREVENTION PLAN

Name:	**Date:**
Signature:	

Name:	**Date:**
Signature:	

Name:	**Date:**
Signature:	

Name:	**Date:**
Signature:	

Name:	**Date:**
Signature:	

6. TRAINING

a. ☐ Safety indoctrination subjects. Employees shall be provided with safety and health indoctrination training prior to the start of work as well as continuous safety and health training to enable them to perform their work in a safe manner. **All training, meetings, and indoctrinations shall be documented in writing by date, attendee signature/name, content, and trainer.**

- Personal protective equipment requirements for project site.
- Job hazards and the means to control/eliminate those hazards, including activity hazard analyses.
- Weekly (employees) and monthly (supervisors) safety meetings.
- Location of portable fire extinguishers.
- Location of first-aid kits.
- Identification of first-aid/CPR qualified personnel (if applicable).
- Location of emergency phone numbers.
- Location of the nearest on-site/off-site medical facility.
- Emergency plans for fires/spills.
- Accident notification and reporting procedures.
- Procedures for reporting and correcting unsafe conditions or practices.
- Current project site safety issues.

Other safety indoctrination subjects:

b. Additional training applicable to the project. The prime contractor will provide employee names working the job along with their years of 'on-the-job' experience in **Appendix E**.

☐ Abrasive blasting**.**

☐ Blasting**.**

☐ Compressed gas cylinders.

☐ Concrete/masonry.

☐ Crane hand signals

☐ Elevating work platforms.

☐ Emergency response (fires/spills).

☐ Formwork/shoring.

☐ Hand/power tools.

☐ Hazard communication.

☐ Lockout/Tagout

☐ Motor/all-terrain vehicles.

☐ Pneumatic tools.

☐ Portable fire extinguishers

☐ Powered industrial trucks

☐ Pressurized equipment/systems

☐ Rotating work platform

☐ Safe lifting techniques

☐ Steel erection

☐ Vehicle-mounted elevating platforms.

☐ Wearing/maintaining PPE.

☐ Welding/cutting**.**

Other training and certifications.

c. Weekly employee safety meetings.

☐ Project manager, safety manager, site safety and health officer, or supervisor will conduct employee safety meetings.

☐ Prime contractor and subcontractor workers will attend employee safety meetings.

Day and time of employee safety meetings is listed below:

Day:	**Time:**
Day:	**Time:**

☐ Meetings will be documented with facilitator and attendee names, date, and subjects discussed.

d. Monthly supervisory safety meetings.

☐ Company owner, safety manager; or project manager will conduct supervisory safety meetings.

☐ Prime contractor and subcontractor supervisors will attend supervisory safety meetings.

Day and time of supervisory safety meeting is listed below:

Day:	**Time:**
Day:	**Time:**

☐ Meetings will be documented with facilitator and attendee names, date, and subjects discussed.

7. SAFETY AND HEALTH INSPECTION

a. ☐ Project site safety inspections.

- Company safety manager (periodically).
- Project manager (periodically).
- Supervisors and foremen (periodically).
- Site safety and health officer (SSHO) (frequently).
- Quality control representative (daily).
- Employees will conduct project site inspections of electrical cords, in-use hand and power tools, and in-use machinery/mechanized equipment (daily).

b. ☐ Inspector qualifications. Prime contractor will provide inspector qualifications for safety manager, SSHO, and quality control representative.

c. ☐ Deficiency log. A deficiency log will be generated after inspections using the criteria listed below. Follow-up inspections will be performed to ensure identified deficiencies have been corrected.

- Date deficiency identified.
- Description of deficiency.
- Name of person responsible for correcting deficiency.
- Projected resolution date.
- Date actually resolved.

d. External inspections. Are external inspections or certifications required? ☐ Yes ☐ No

If yes please explain.

8. ACCIDENT REPORTING

a. ☐ **Exposure data.** Man-hours worked will be reported input into the QCS system by the 25th of every month. If QCS is not used, an approved form may be used and submitted.

b. ☐ **Accident notification.** Prime contractor will report accidents and incidents as soon as they happen to the contracting officer's representative (COR). The COR, in turn, will notify the AED Safety Office according to the notification information below. **For accidents and incidents that require immediate notification the prime contractor will seal-off the site and await for the AED board of investigation team.**

Immediate notification (telephonically).

- Fatality.
- Permanent total disability.
- Permanent partial disability.
- Three or more persons admitted to a hospital.
- Property damage of $200,000 damage or more.

For all other accidents below, report as soon as possible but not more than 24-hours following the accident (telephonically and/or email).

- Lost time (**Note:** Lost time is defined as any loss of time away from work beyond the day or shift on which it occurred).
- Property damage not less than $2,000 but no greater than $200,000.
- Treatment of medical injuries not resulting in lost time.

c. ☐ **Accident recording.** Prime contractor will coordinate with the COR on forwarding the appropriate documents to the AED Safety Office.

Reportable accident and incident requirements. All accidents and incidents to include occupational injuries and illnesses that result in medical treatment with no lost time, and property damage of less than $2,000, will be documented in an email and sent to the AED Safety Office within 24 hours.

Recordable accident and incident requirements. All accidents and incidents to include occupational injuries and illnesses that result in lost time (measured in days) or property damage of $2,000 or more will be documented on ENG Form 3394 'U.S. Army Corps of Engineers Accident Investigation Report' dated March 1999 and submitted to the AED Safety Office within five (5) days of the occurrence.

9. PLANS (PROGRAMS, PROCEDURES)

A. LAYOUT PLAN – MUST INSERT IN APPENDIX F.

B. EMERGENCY RESPONSE PLAN – SEE APPENDIX G.

C. MEDICAL SUPPORT.

a. General requirements.

☐ An effective means of communication (hard-wired, cellular, or two-way radio and tested in the area of use for functionality) with emergency response source access will be provided along with transportation for injured workers.

☐ Telephone numbers of medical facilities, physicians, and ambulances will be conspicuously posted (at a minimum these numbers will be posted near project-office telephones).

☐ A map showing the best route to the nearest medical facility will be conspicuously posted.

Medical Facility Name:
Address:
Phone Number(s):
Distance to the nearest Medical Facility:

b. Type of medical support. Mark one box to indicate the number of employees anticipated on site (less than 100; 99 to 300; or more than 300).

☐ **Less than 100 persons employed on any one shift.** On sites with less than 100 workers, and where neither a first-aid station nor infirmary is available, prime contractor will provided a first-aid kit for every 25 persons. These kits will have latex gloves and a CPR shield.

Location of first-aid kits.

☐ **Trained first-aid/CPR employees.** Prime contractor will have at least two employees on each shift trained to administer first-aid/CPR when a medical facility or physician is not accessible within five minutes of an injury to a group of two or more employees. Provide training certificates or copy of certification card.

Employee Name:	Certification expiration date:
Employee Name:	Certification expiration date:

☐ **More than 99 but less than 300 persons employed on any one shift.** On sites with more than 99 but less than 300 workers the prime contractor will establish and equip, as directed by a licensed physician, a first-aid station. Identification signs and directional markers will be used to denote the station's location. Emergency lighting will be provided and a first-aid attendant will be on duty at all hours when work is in progress.

☐ **300 or more persons employed on any one shift.** On sites with 300 or more workers the prime contractor will establish and equip, as directed by a licensed physician, an infirmary. Identification signs and directional markers will be used to denote the infirmary's location and emergency lighting will be provided.

Infirmaries will provide reasonably quiet conditions with some privacy, lighting, climate control, adequate toilet facilities, hot and cold water, drainage, and electrical outlets. Walls and ceilings will be finished with two coasts of white paint, windows and doors screened, and the floors made of impervious construction.

A properly-equipped emergency vehicle, helicopter, or mobile first-aid unit will be provided during work hours (the emergency vehicle will not be used for any other purpose). A registered nurse, licensed physician's assistant, certified emergency medical technician, or a licensed practical nurse (approval by a licensed physician) will be assigned on a full-time basis to each work site.

D. PERSONAL PROTECTIVE EQUIPMENT (PPE).

a. General Requirements.

☐ Prime contractor will conduct hazard assessments to find out the type(s) of PPE required.

☐ Prime contractor will ensure workers know how to put on, adjust, wear, remove, and use PPE. PPE will be inspected before each use, maintained in a serviceable and sanitary condition, and stored so the integrity of the equipment is protected. This training will be documented with the name of the facilitator/attendees, date, and subjects taught.

☐ Damaged and defective equipment will not be used but rather marked 'out-of-service' and removed from the project site.

b. PPE used on the project site.

☐ Minimum required clothing.
☐ Hard hat.
☐ Safety glasses/goggles.
☐ Face shield.
☐ Ear plugs/muffs.
☐ Work gloves.
☐ Welding gloves.
☐ Steel-toed/hard-soled shoes.
☐ Welding helmet.
☐ Welding goggles.
☐ Welding hand-held shields.
☐ Full-body harness w/lanyard(s).
☐ Reflective vest.
☐ Dust mask.
☐ Half-face/full-face respirator.
☐ Life ring.
☐
☐

Other PPE used on the project site.

<u>E. OTHER PLANS:</u> Must check if "YES" or NA (not applicable) for all listed plans. If you check "YES" then you must mark the box in section E.1 and insert your company plan at Appendix H when a written plan is required.

PLAN NAME	YES	NA	PLAN NAME	YES	NA
Plan for prevention of alcohol and drug abuse (01.C.02)			Contingency plan for severe weather (19.A.03);		
Site sanitation plan (Section 02)			Float Plan (19.F.04);		
Access and haul road plan (4.B)			Site-Specific Fall Protection & Prevention Plan (21.C);		
Respiratory protection plan (05.G)			Demolition plan (to include engineering survey) (23.A.01);		
Health hazard control program (06.A)			Excavation/trenching plan (25.A.01);		
Hazard communication program (06.B.01)			Emergency rescue (tunneling) (26.A.);		
Lead abatement plan (06.B.05 & specifications);			Underground construction fire prevention and protection plan (26.D.01);		
Asbestos abatement plan (06.B.05 & specifications);			Compressed air plan (26.I.01);		
Safety Program (06.E.03.a);			Formwork and shoring erection and removal plans (27.C);		
Abrasive blasting (06.H.01);			PreCast Concrete Plan (27.D);		
Heat/Cold Stress Monitoring Plan (06.I.02)			Lift slab plans (27.E);		
Crystalline Silica Monitoring Plan (Assessment) (06.M) ;			Steel erection plan (27.F.01);		
Night operations lighting plan (07.A.08);			Site Safety and Health Plan for HTRW work (28.B);		
Fire Prevention Plan (09.A);			Blasting Safety Plan (29.A.01);		
Wild Land Fire Management Plan (09.K);			Diving plan (30.A.13);		
Hazardous energy control plan (12.A.01);			Confined space Program (34.A).		
Critical lift Plan (16.H);					

☐ **Temporary facilities/layout plan (Section 4.A.01).**
☐ **NA.**
*****Written Company plan required**

☐ **Emergency response plans for fires/spills (Section 01.E.01).**
☐ **NA.**
*****Written Company plan required.**

- Discuss escape procedures and routes.
- Designate critical project site operations and discuss how the operations will be protected.
- Discuss employee accountability procedures following an evacuation.
- Discuss employee roles in emergencies to include responsibilities and equipment used.
- Discuss the location of emergency contact information to include reporting procedures.

☐ **Plan for Prevention of Alcohol and Drug Abuse (Section 01.C.02).**
☐ **NA.**
*****Written Company plan required**

☐ **Site sanitation plan (Section 02.A).**
☐ **NA.**
No written plan required.

- An adequate supply of drinking water (cool water during hot weather) will be provided.
- Portable drinking-water dispensers will have a tap – water will not be dipped. Dispensers will be clearly marked as "Drinking Water" and will be capable of being closed. Use of a common cup will be prohibited unless sanitized between uses.
- When sanitary sewers are not available porta-johns will be provided.
- Washing facilities will have running water, soap, and an individual means of drying (hand sanitizer will be used when running water is not practical).
- No food or beverage will be stored or consumed in a toilet room or in any area that is exposed to a toxic material.
- An adequate number of waste receptacles will be provided. Receptacles will have covers that fit tightly, be emptied at least daily, and be maintained in a sanitary condition.

☐ **Access and haul roads plan (Section 04.B).**
☐ **NA.**
*****Written Company plan required.**

- Discuss equipment to be used on the road, traffic density, and the hours of operation.
- Discuss road layout and widths, horizontal and vertical curve data, and sight distances.
- Discuss sign and signalperson requirements, road markings, and traffic-control devices.
- Discuss how drainage will be controlled.

- Outline contact between vehicles and the public to include implementing safety controls at each one of these places.
- Discuss the maintenance needed to keep the roads hard, smooth, and as dust-free as possible.

☐ **Respiratory protection plan (Section 05.G).**
☐ **NA.**
*****Written Company plan required.**

- Discuss the use of dust masks to protect workers from large particulate matter.
- Discuss the use of half-faced respirators to protect workers from small particulate matter to include fumes, mists, and aerosols.
- Discuss sealing a half-face respirator properly.
- Discuss cleaning a half-faced respirator properly
- Discuss inspecting and storing a half-face respirator properly.

☐ **Health hazard and control plan (Section 06.A).**
☐ **NA.**
*****An activity hazard analysis (AHA) will be completed for each applicable area.**

- Discuss hazardous substances.
- Discuss hot substances (heating devices and melting kettles).
- Discuss harmful plants, animals, and insects.
- Discuss ionizing radiation.
- Discuss the use of lasers.
- Discuss ventilation and exhaust systems.

☐ **Hazard communication plan (Section 06.B.01).**
☐ **NA.**
*****Written Company plan required.**

- A current inventory of project site hazardous chemicals will be prepared.
- Material safety data sheets for hazardous substances will be kept at the project site.
- Containers will be labeled with the type of hazardous substance they contain.
- Workers will be notified about new substances that are brought onto the worksite to include the hazards associated with them.

☐ **Lead Abatement Plan (Section 06.B.05).**
☐ **NA.**
*****Written Company plan required.**

☐ **Asbestos Abatement Plan (Section 06.B.05).**
☐ **NA.**
*****Written Company plan required.**

☐ **Confined space plan (Section 34.A.).**
☐ **NA.**
*****Written Company plan required.**

- Discuss responsibilities of attendants, entrants, and entry supervisors.
- Train workers how testing and monitoring equipment is used.
- Discuss the type of ventilating equipment needed to obtain acceptable entry conditions.
- Discuss the type of communication equipment to be used.
- Discuss the PPE to be used when engineering and/or administrative controls fail to protect workers adequately.
- Discuss the lighting equipment to be used.
- Discuss the equipment to be used for entrant ingress and egress.
- Discuss rescue procedures to include required equipment and emergency phone numbers.

☐ **Hazardous energy control plan (Section 12.A.12).**
☐ **NA.**
*****Written Company plan required.**

- Discuss why the lock out/tag out procedure is being used.
- Communicate and coordinate the lockout/tagout procedure with the workers being affected by the procedure and the government's designated authority.
- Discuss the procedural steps in place for shutting down, isolating, blocking, and securing systems to control the release of hazardous energy to include the person(s) responsible for performing this task.
- Discuss the procedural steps in place for placing, removing, and transferring lockout/tagout devices to include the person(s) responsible for performing this task.
- Discuss the procedural steps in place for placing and removing locks and/or tags to include the person(s) responsible for performing this task.
- Discuss the procedures for testing the effectiveness of isolating hazardous energy to include lockout/tagout.
- Discuss emergency scenarios that could arise during the lockout/tagout procedure to include the actions to be taken for safely responding to an emergency.
- Discuss the procedure for transferring removal authority from one person to another.

☐ **Critical lift plan (Section 16.H.02).**
☐ **NA.**
*****Written Company plan required.**

- Designate a crane operator, lift supervisor, and rigger (and state their qualifications).
- Describe ground conditions and outrigger and crawler track requirements.
- Discuss crane position, height of the lift, load radius, and boom angle and length for the entire range of the lift.

- Discuss the size and weight of the load to include any crane and rigging components that add to the weight.
- Discuss the rigging plan to include lift points, hardware requirements, and procedures.
- Discuss coordination of the lift and how individual players will communicate with each other.
- Discuss tandem and tailing-crane lift procedures, if applicable.
- Describe environmental conditions which, when in effect, will stop the lift.

☐ **Demolition plan (Section 23.A.01).**
☐ **NA.**
*****Written Company plan required.**

- A demolition plan based on engineering, lead, and asbestos surveys will be prepared.
- Utilities and other service lines will be shut-off, capped, or otherwise controlled outside the building line.
- Service lines will be temporarily relocated and protected if utilities are maintained.
- If hazardous building materials and chemicals, flammable materials, explosives, gases, or other dangerous substances have been used in building construction, pipes, tanks, or other equipment on the property they will be controlled or eliminated before demolition begins.
- Glass fragmentation will be controlled.
- Mechanical equipment will not be used on floors or other working surfaces unless the floors and surfaces are of sufficient strength to support the loads.
- Chute openings will be protected by a guardrail 42” in height. When debris is dropped through floor openings without chutes, the openings and the area onto which the material is dropped will be enclosed with barricades not less than 42” in height and not less than 6’ back from the protected edge of the opening above. Signs warning of the fall-material hazard will be posted at each side of the debris opening at each floor.
- No wall section more than 6’ in height will stand without lateral bracing unless the wall was designed and constructed to stand without this support and its condition is determined safe enough to be self-supporting.
- Workers will not be allowed in the area directly underneath floor arches when they’re being removed. The area will be barricaded to prevent access and signed to warn of the hazard.
- Steel construction will be dismantled column-by-column and tier-by-tier (columns may be in two-story lengths).

☐ **Compressed air and gas systems plan (Section 20.B).**
☐ **NA.**
No written plan required.

- Compressors and related equipment will be located so safe access is provided to all parts of the equipment for operation, maintenance, and repairs.
- Air hose, pipes, valves, filters, and other fittings will be pressure-rated by the manufacturer and not exceeded. Defective hose will be removed from service.
- Hose will not be laid over walkways, steps, ladders, and scaffolds to create a tripping hazard.
- Compressed air will not be used to blow dirt from the hands, face, or clothing.
- A speed governor independent of the unloaders will be installed on air compressors except those driven electrical induction or electrical synchronized motors.
- Piping will be equipped with traps or other means for removing liquid from the lines.
- Air receivers will be installed so that all drains, hand holes, and manholes are accessible.

☐ **Formwork/shoring (Section 27.C.02.b).**
☐ **NA.**
*****Written Company plan required.**

- Formwork, shoring, and bracing will be erected and maintained to safety support all vertical and lateral loads that might be applied until such loads can be supported by the structure.
- Sills will be sound, rigid, and capable of carrying the maximum intended load.
- Base plates, shore heads, extension devices, or adjustment screws will be in firm contact with the sill and form material and, as applicable, will be snug against the posts.
- Diagonal bracing will be provided in vertical and horizontal planes to provide stiffness and to prevent buckling of the individual members.
- Forms and shores (except those on slab or grade and slip forms) will not be removed until the concrete has gained sufficient strength to support its weight and all superimposed loads.

☐ **Lift-Slab Operations (Jacking plan) (Section 27.E).**
☐ **NA.**
*****Written Company plan required.**

- Manufacturer's rated capacity will be legibly marked on all jacks and not exceeded.
- Jacks will be designed and installed so they won't continue to lift when overloaded.
- Jacks will have a positive stop to prevent over-travel.
- Base of the jack will be blocked or cribbed. If there's a possibility of slippage a wood block will be placed between the jack's metal cap and the load.
- Maximum number of manually-controlled jacks on one slab will be limited to 14.
- During lifting all point of the slab support will be kept within ½" of that needed to maintain the slab in a level position.
- No one will be permitted under the slab during jacking operations.

☐ **Personal Fall Protection Program (Section 21.C.01).**
☐ **NA.**
*****Written plan required.**

- Workers will be protected by guardrail, personal fall protection, safety nets, catch platforms, or temporary floors in the following situations: Worker can fall 6' or more; on access ways or work platforms over water, machinery, or dangerous operations; on runways where workers can fall 4' or more; and on all exposed sides of stairways and ladder-floor openings.
- Top rails, mid rails, and toe boards will be able to withstand outward and downward forces of 200, 150, and 50 lbs., respectively.
- Wire rope can be used as a top or mid rail under the following conditions: When the posts are spaced no farther than 8"; deflection of the rope under 200 lbs. of force is less than 3"; and the rope if flagged for visibility. Synthetic and natural-fiber rope will not be used.
- Paneling and screening will be in place from the mid rail to the toe board when material is piled higher than the toe board.
- Personal fall protection will consist of a full-body harness (not chest-wait units or body belts), lifeline, and anchorage point.

- Two lanyards will be used when vertical movement is required and when a horizontal lifeline is inappropriate.
- Anchorages capable of supporting 5,000 lbs. per worker will be independent of anchorages used to support or suspend platforms. Lifelines will not be attached to guardrails or hoists but rather to the structure.
- Floor holes will be covered completely and securely. If the cover to an open hole is missing the hole will be barricaded with a guardrail. Workers laboring by wall openings 6' or more above a lower level will be protected by a guardrail or personal fall protection.
- Roofers will be protected by the following forms of fall protection: Guardrails; personal fall protection; a warning line 6' from the roof's edge, or a safety-monitoring system.
- Excavations will be guarded when they are 6' or more in depth and not readily seen because of plant growth or other visual barriers.

☐ **Steel Erection Plan (Section 27.F).**
☐ **NA.**
*****Written Company plan required.**

☐ **Night operations lighting plan (Section 7.A.08).**
☐ **NA.**
*****Written Company plan required.**

☐ **Fire Prevention Plan (Section 09.A).**
☐ **NA.**
*****Written Company plan required.**

- Discuss the major worksite fire hazards to include potential ignition sources.
- Describe the types of fire-suppression systems to be used (portable fire extinguishers, ect.).
- Discuss employee responsibilities for maintaining the fire-prevention equipment and systems.
- Discuss employee responsibilities for controlling fuel-source hazards.
- Discuss housekeeping procedures to include the removal of waste materials.

☐ **Excavations (Section 25.A).**
☐ **NA.**

*****Written Company plan and AHA required for excavations or trenches greater than 5 ft (1.5 m) in depth. For excavations or trenches less than 5 ft (1.5 m) in depth, An AHA is required but plan is optional.**

- Workers will not labor in excavations in which there is accumulated water or where water is accumulating until the water hazard is controlled.
- Shoring will be used for unstable soil or depths greater than 5' unless benching, lay-back, or another acceptable plan can be implemented.
- In excavations less than 20' in depth the maximum slope will be 34 degrees measured from horizontal (1 1/2' horizontal to 1' vertical).
- Excavations will not go below adjacent structures unless they are underpinned or determined safe by a registered professional engineer.
- Excavated material will be placed a minimum of 2' from the excavation's edge.

- Stairs, ramps, or ladders will be provided to workers who are required to enter excavations greater than 4' in depth. This equipment will be located so no more than 25' of lateral travel is required to escape the excavation.
- Ladders will extend 3' past the excavation's edge.
- Personal access ramps will be 4' wide with guardrails while equipment ramps will be 12' wide with curbs of 8" X 8" timbers or equivalent.
- Protection for excavations exposed to the public will meet guardrail requirements while protection against vehicles will be able to withstand the impact forces with traffic.
- Excavations 6' or more in depth, or where workers are routinely exposed to a hazard (impalement or hazardous material), will have a barricade no closer to the edge than 6' with a warning (tape, flags, act.) located 3-4' above the ground.
- Excavations less than 6' in depth will have a barricade no closer than 6"/no farther than 6'.

☐ **Scaffolds (Section 21.J.01, 21.J.02 on page 509 and 22.A and 22.B).**
☐ **NA.**
No written plan required (included as part of the Fall Protection Plan).

- Scaffolds will be level and plumb and erected with base plates upon mudsills or other adequate foundation. Rolling scaffolds will have wheels locked and/or outriggers secured in place.
- Work near overhead power lines will not commence until a survey is made to ascertain a safe clearance distance from the lines. Scaffolds will not be erected or used near power lines until the lines are insulated, de-energized, or rendered safe.
- Scaffolds and their components will be capable of supporting four times the maximum anticipated load. If a scaffold's height is more than four times the minimum base dimension (to include the width added by outriggers) it will be secured to the wall or structure.
- Guardrails will be installed on open sides and ends.
- Platforms will be a minimum of 18" in width and extend over their end supports by at least 6" but no more than 12" unless cleated or restrained by hooks or equivalent means. Platforms will overlap over supports by a minimum of 12" unless nailed together or restrained from movement.
- Platform area will be fully-planked with no greater than 1" gaps between adjacent platforms, and platforms and uprights.
- Scaffold access will be from ladders (bottom rung no greater than 24" in height), stair towers, ramps, and walkways but not from cross-braces.
- If a worker can fall 6' or more to a lower level they will be protected by a guardrail or a full-body harness with lifeline and anchorage point.

☐ **Machinery/mechanized equipment (Section 18.G).**
☐ **NA.**
No written plan required.

- Before machinery and mechanized equipment is placed into service it will be inspected and certified as safe by a competent person.
- Front-end loaders, bulldozers, backhoes, cranes, and similar equipment will have at least one dry chemical or CO2 portable fire extinguisher on-board with a minimum rating of 5-B:C.
- Self-propelled construction equipment will have a reverse signal alarm.

- Belts, gears, chains, shafts, pulleys, drums, and other rotating and moving equipment parts will be guarded when exposed to contact by persons or when they otherwise create a hazard.
- Crane will operate at least 10' away from overhead power lines.
- An operating manual, log book, load chart, and document detailing operating limits in windy or cold weather conditions will be in the cab when the crane is operating.
- Crane will be within one degree of level and outriggers fully-extended when in use. Wheels will be off the ground at every setting.
- Crane outrigger floats will be securely attached. Float blocking will be of sufficient size and stability to support the total area. Blocking will not be performed under the outrigger beams.
- Crane's rear swing radius will be barricaded.
- Riding on or standing under loads is prohibited.

☐ **Electrical (Section 11).**
☐ **NA.**

*****A sketch of proposed temporary power distribution system shall be submitted. No written plan required.**

- Electrical work shall be performed by Qualified Personnel with verifiable credentials.
- An AHA and written work procedures must be prepared for unusual or complicated work activities or any activity identified by the Qualified Person.
- Work activity adjacent to energized overhead power lines will not be initiated until a survey has been made to ascertain the safe clearance distance from the lines.
- Whenever possible, all circuits and equipment will be de-energized before work is started and personnel protected by lockout/tagout and clearance procedures, and grounding.
- Live parts of wiring or equipment will be guarded.
- Transformer banks and high-voltage equipment will be protected against unauthorized access and those entrances not under constant observation will be kept locked. Metallic enclosures will be grounded and signs warning of high voltage and prohibiting unauthorized entrance posted.
- Flexible cords will be inspected by the user daily. Cord sets used on construction sites or in damp locations will contain an equipment ground wire and have a plug attached.
- Flexible cords will be protected from damage caused by vehicles, foot traffic, sharp corners, and pinching. Cords passing through holes will be protected by suitable means.
- Flexible cords will only be used in continuous lengths. Cords No. 12 or larger may be used with a splice if the splice is made by a qualified electrician, the insulation is equal to the cord being spliced, and the wire connections are soldered. No wire nuts will be used.
- Flexible cords and cables will not be secured by staples or hung from nails or bare wire.
- Enclosures containing over-current protective devices will be provided with lockable, close-fitting doors. Circuit-breakers, switches, fuse panels, and motor controllers located out-of-doors or in wet locations will be contained in weatherproof enclosures or cabinets. When receptacles are used in wet locations they will be contained in a weatherproof enclosure the integrity of which is not affected when a plug is inserted.
- All electrical circuits will be grounded.
- Portable and semi-portable electrical tools and equipment will be grounded by a multi-conductor cord having a polarized plug with a grounding conductor. Double-insulated tools do not have to be grounded.
- Grounding rods with pipe electrodes will be used in 8' lengths and driven to full depth.
- Temporary lights will not be suspended by their electric wire unless designed for suspension.

- Bulbs attached to temporary lighting strings and extension cords will be protected by guards. Empty light sockets (broken bulbs, ect.) will be immediately filled.
- All receptacle outlets that provide temporary electrical power during construction or demolition shall have GFCI protection.

10. RISK MANAGEMENT PROCESS (AHA – ACTIVITY HAZARD ANALYSIS)

For each major phase/activity of work an Activity Hazard Analysis shall be provided detailing project-specific work sequences, the specific anticipated hazards, control measures to be implemented to eliminate or reduce each hazard, the equipment to be used, inspection requirements, and required training.

Work shall not begin until the AHA for the work activity has been accepted by the COR or Safety Office and discussed with all engaged in the activity including the contractor and subcontractor(s) .

The names of the Competent/Qualified Person(s) required for a particular activity shall be identified and included in the AHA.

The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified personnel.

Attach AHAs for the first three features of work to Appendix I.

ACTIVITY HAZARD ANALYSIS

ID No.	**FEATURE OF WORK:**	
Contract No.	**Project:**	**Location:**
Date:	**Activity:**	**Estimated Start Date:**
PRINCIPAL STEPS	**POTENTIAL SAFETY/HEALTH HAZARDS**	**RECOMMENDED CONTROLS**
Identify the principal steps involved and the sequence of work activities.	***Analyze each principal step for potential hazards.***	***Develop specific controls to eliminate or reduce each hazard to an acceptable level of risk.***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
List equipment to be used in the work activity.	***List inspection requirements for the work activity.***	***List training requirements, include hazard communication.***
Prepared by: Contractor's competent/qualified person(s) (Signature & Date)		
☐ **- AHA Accepted as Part of project Accident Prevention Plan; or** ☐ **- This AHA has been reviewed by the designated AED COR and is acceptable for use on this project. This acceptance is predicated on satisfactory implementation in the field by the contractor and will be rescinded if the contractor fails to enforce the controls identified in this document and/or the requirements identified in EM385-1-1. This AHA will be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).**		**Name, COR (Signature & Date)**

APPENDIX A

SITE MAP

APPENDIX B.

STATEMENT OF SAFETY AND HEALTH POLICY

APPENDIX C.

RESPONSIBILITIES AND LINES OF AUTHORITY

Resumes and Training Certificates Of Safety Personnel

APPENDIX D.

RESPONSIBILITIES AND LINES OF AUTHORITY

1. Proof of competency / qualification (Resumes and certificates) for Competent/Qualified persons listed below.

2. Organization Chart (with names) for Key Corporate and Project personnel.

3. Corporate/Company Incentive Program and/or Worker Non-Compliance Program (if not using generic option).

Confined space.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Cranes/derricks.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Electrical.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Excavations.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Explosive-actuated tools.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Fall Protection.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Machinery/mechanized equipment.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Respiratory Protection

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Rigging

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

Scaffolding.

Name:	**Training:**
Name:	**Training:**
Name:	**Training:**

APPENDIX E.

TRAINING

SPECIFIC WORKER TRAINING

Abrasive blasting.

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Blasting.

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Compressed gas cylinders.

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Concrete/Masonry

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Crane Hand Signals

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Elevating Work Platforms

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Emergency Response

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Formwork/Shoring

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Hand/Power Tools

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Hazard Communication

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Hazardous Waste

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Lockout/tagout.

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Motor/all-terrain vehicles

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Pneumatic tools

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Portable Fire Extinguishers

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Powered Industrial Trucks

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Pressurized Equipment/systems

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Rotating Work Platform

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Safe Lifting Techniques

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Steel Erection

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Vehicle-Mounted Elevating Platforms

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Wearing/Maintaining PPE

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

Welding/cutting

Name:	**Years of Experience:**
Name:	**Years of Experience:**
Name:	**Years of Experience:**

APPENDIX F.

LAYOUT PLAN

APPENDIX G.

EMERGENCY RESPONSE PLAN

APPENDIX H.

REQUIRED WRITTEN PLANS

APPENDIX I.

RISK MANAGEMENT PROCESSES (AHA – ACTIVITY HAZARD ANALYSIS)

ACTIVITY HAZARD ANALYSIS

ID No.	**FEATURE OF WORK:**	
Contract No.	**Project:**	**Location:**
Date:	**Activity:**	**Estimated Start Date:**
PRINCIPAL STEPS	**POTENTIAL SAFETY/HEALTH HAZARDS**	**RECOMMENDED CONTROLS**
Identify the principal steps involved and the sequence of work activities.	***Analyze each principal step for potential hazards.***	***Develop specific controls to eliminate or reduce each hazard to an acceptable level of risk.***
EQUIPMENT TO BE USED	**INSPECTION REQUIREMENTS**	**TRAINING REQUIREMENTS**
List equipment to be used in the work activity.	***List inspection requirements for the work activity.***	***List training requirements, include hazard communication.***
Prepared by: Contractor's competent/qualified person(s) (Signature & Date)		
☐ **- AHA Accepted as Part of project Accident Prevention Plan; or** ☐ **- This AHA has been reviewed by the designated AED COR and is acceptable for use on this project. This acceptance is predicated on satisfactory implementation in the field by the contractor and will be rescinded if the contractor fails to enforce the controls identified in this document and/or the requirements identified in EM385-1-1. This AHA will be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s).**		**Name, COR (Signature & Date)**

SPECIFICATION SECTION 01770

CLOSEOUT PROCEDURES

1. GENERAL

1.1 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 01335 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Equipment/Product Warranty List; G

Submit Data Package 1 in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

As-Built Drawings; G

Record Of Materials; G

Equipment/Product Warranty Tag; G

1.2 PROJECT RECORD DOCUMENTS

1.2.1 AS-BUILT DRAWINGS

As built drawings shall be submitted in accordance with Section 01780A CLOSEOUT SUBMITTALS

1.2.2 AS-BUILT RECORD OF MATERIALS

Furnish a record of materials.

Where several manufacturers' brands, types, or classes of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces depicted on the contract drawing. Furnish the record of materials used in the following format:

MATERIALS DESIGNATION	SPECIFICATION	MANUFACTURER	MATERIALS USED (MANUFACTURER'S DESIGNATION)	WHERE USED

1.3 EQUIPMENT/PRODUCT WARRANTIES

1.3.1 EQUIPMENT/PRODUCT WARRANTY LIST

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
6. Cross-reference to warranty certificates as applicable.
7. Starting point and duration of warranty period.
8. Summary of maintenance procedures required to continue the warranty in force.
9. Cross-reference to specific pertinent Operation and Maintenance manuals.

10. Organization, names and phone numbers of persons to call for warranty service.

11. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 PERFORMANCE OF WARRANTY WORK

In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

Following oral or written notification of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.3.3 PRE-WARRANTY CONFERENCE

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.4 WARRANTY TAGS

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature

shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____

b. Model number_____

c. Serial number_____

d. Contract number_____

e. Warranty period _____ from _____ to_____

f. Inspector's signature_____

g. Construction Contractor_____

Address_____

Telephone number_____

h. Warranty contact_____

Address_____

Telephone number_____

i. Warranty response time priority code_____

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING AND BALANCING

All contract requirements for testing/adjusting/balancing shall be fully completed, including all testing, prior to contract completion date. The time required to complete all testing/adjusting/balancing is included in the allotted calendar days for completion.

1.5 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

-- END OF SECTION --

SECTION 01780A

CLOSEOUT SUBMITTALS

1. GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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 01335 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

As-Built Drawings

Drawings showing final as-built conditions of the project. The final CAD as-built drawings shall consist of **two sets** of electronic CAD drawing files in the specified format (see the AED CAD Design Requirements: CAD Design Guide), and **two half-size and two full-size paper copies** of the approved as-built drawings..

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags

Two record copies of the warranty tags showing the layout and design.

Final Cleaning

Two copies of the listing of completed final clean-up items.

1.2 PROJECT RECORD DOCUMENTS

1.2.1 AS-BUILT DRAWINGS

This paragraph covers as-built drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working

as-built drawings" and "final as-built drawings" refer to contract drawings which are revised to be used for final as-built drawings.

1.2.1.1 GOVERNMENT FURNISHED MATERIALS

One set of electronic CAD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CAD file as-built drawings.

1.2.1.2 WORKING AS-BUILT AND FINAL AS-BUILT DRAWINGS

a. The Contractor shall revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. These working as-built marked drawings shall be kept current on a weekly basis and at least one set shall be available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final as-built drawings shall be prepared after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. In addition, if the Contractor fails to provide the final as-built drawings within thirty (30) calendar days after contract completion, the Contracting Officer will deduct from the final contract payment an amount representing the lesser of 1% of the total contract cost or $50,000. The working and final as-built drawings shall show, but shall not be limited to, the following information:

b. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall also be recorded.

c. The location and dimensions of any changes within the building structure.

d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

g. Changes or modifications which result from the final inspection.

h. Where contract drawings or specifications present options, only the option selected for construction shall be shown on the final as-built prints.

i. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, the Contractor shall furnish a contour map of the final borrow pit/spoil area elevations.

j. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

k. Modifications (change order price shall include the Contractor's cost to change working and final as-built drawings to reflect modifications) and compliance with the following procedures.

1. Directions in the modification for posting descriptive changes shall be followed.
2. A Modification Circle shall be placed at the location of each deletion.
3. For new details or sections which are added to a drawing, a Modification Circle shall be placed by the detail or section title.
4. For minor changes, a Modification Circle shall be placed by the area changed on the drawing (each location).
5. For major changes to a drawing, a Modification Circle shall be placed by the title of the affected plan, section, or detail at each location.
6. For changes to schedules or drawings, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.
7. The Modification Circle size shall be 12.7 mm 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 DRAWING PREPARATION

The as-built drawings shall be modified as may be necessary to correctly show the features of the project as it has been constructed by bringing the

contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints shall be neat, legible and accurate. These drawings are part of the permanent records of this project and shall be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

1.2.1.4 COMPUTER AIDED DESIGN AND DRAFTING (CAD) DRAWINGS

a. Only personnel proficient in the preparation of CAD drawings shall be employed to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings shall be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols shall be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final as-built drawings shall be identical to that used on the contract drawings. Additions and corrections to the contract drawings shall be accomplished using CAD files. The Contractor will be furnished "as-designed" drawings in AutoCAD Release 2007 or Microstation V8 format compatible with a Windows XP operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). The Contractor shall be responsible for providing all program files and hardware necessary to prepare final as-built drawings.

b. Prior to submittal of the first design submittal involving CAD drawings, the Contractor shall prepare one typical CAD drawing for the project and furnish, via ENG Form 4025, the electronic CAD drawing file for review and approval by the Contracting Officer. All Government comments involving changes to this single drawing shall be accomplished and resubmittal(s) made until the Government is satisfied that all CAD Standards are being followed and all subsequent drawings will also be in compliance with these Standards.

c. CAD colors shall be the "base" colors of red, green, and blue. Color code for changes shall be as follows:

1. Deletions (red) - Deleted graphic items (lines) shall be colored red with red lettering in notes and leaders.
2. Additions (Green) - Added items shall be drawn in green with green lettering in notes and leaders.
3. Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes shall be in blue.

d. The Contract Drawing files shall be renamed in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Marked-up changes shall be made only to those renamed files. All changes shall be made on the layer/level as the original item. There shall be no deletions of existing lines; existing lines shall be over struck in red. Additions shall be in green with line

weights the same as the drawing. Special notes shall be in blue on layer#63.

e. When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the Contractor in letters at least 5 mm 3/16 inch high. All other contract drawings shall be marked either "As-Built" drawing denoting no revisions on the sheet or "Revised As-Built" denoting one or more revisions. Original contract drawings shall be dated in the revision block.

f. After Government approval of all of the working as-built drawings for a phase of work, the Contractor shall prepare the final CAD as-built drawings for that phase of work and submit two sets of full size paper copy prints of these drawings for Government review, comparison with approved red-line marked up drawings, and approval. The Government will promptly return one set of prints annotated with any necessary corrections to the CAD file(s) if corrections are required prior to approval. Within 20 days of substantial completion of all phases of work, the Contractor shall submit the final as-built drawing package for the entire project. The submittal shall consist of one set of electronic files on compact disc, read-only memory (CD-ROM), one set of full size paper prints and one set of the approved working as-built drawings. They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the CAD system. Upon approval by the Government of the final as-built drawing package for the entire project, the Contractor shall provide the number of as-built copies noted in Paragraph 1.1 of this Section.

g. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final as-built drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.5 PAYMENT

No separate payment will be made for as-built drawings required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

1.2.2 AS-BUILT RECORD OF EQUIPMENT AND MATERIALS

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Two sets of final record of equipment and materials shall be submitted 10 days after final inspection. The designations

shall be keyed to the related area depicted on the contract drawings. The record shall list the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.2.3 FINAL APPROVED SHOP DRAWINGS

The Contractor shall furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.2.4 CONSTRUCTION CONTRACT SPECIFICATIONS

The Contractor shall furnish final as-built construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.2.5 REAL PROPERTY EQUIPMENT

The Contractor shall furnish a list of installed equipment furnished under this contract. The list shall include all information usually listed on manufacturer's name plate. The "EQUIPMENT-IN-PLACE LIST" shall include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished 30 days after transfer of the completed facility.

1.3 WARRANTY MANAGEMENT

1.3.1 WARRANTY MANAGEMENT PLAN

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of

acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
6. Cross-reference to warranty certificates as applicable.
7. Starting point and duration of warranty period.
8. Summary of maintenance procedures required to continue the warranty in force.
9. Cross-reference to specific pertinent Operation and Maintenance manuals.
10. Organization, names and phone numbers of persons to call for warranty service.
11. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.3.2 PRE-WARRANTY CONFERENCE

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be

established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.3.3 CONTRACTOR'S RESPONSE TO CONSTRUCTION WARRANTY SERVICE REQUIREMENTS

Following oral or written notification by the Contracting Officer, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems
1) Recreational support.
2) Air conditioning leak in part of building, if causing damage.
3) Air conditioning system not cooling properly.

Code 1-Doors
1) Overhead doors not operational, causing a security, fire, or safety problem.
2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
1) Overhead doors not operational.
2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
1) Power failure (entire area or any building operational after

1600 hours).
2) Security lights
3) Smoke detectors

Code 2-Electrical
1) Power failure (no power to a room or part of building).
2) Receptacle and lights (in a room or part of building).

Code 3-
Electrical
Street
lights.

Code 1-Gas
1) Leaks and breaks.
2) No gas to family housing unit or cantonment area.

Code 1-Heat
1) Area power failure affecting heat.
2) Heater in unit not working.

Code 2-Kitchen Equipment
1) Dishwasher not operating properly.
2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
1) Hot water heater failure.
2) Leaking water supply pipes.

Code 2-Plumbing
1) Flush valves not operating properly.
2) Fixture drain, supply line to commode, or any water pipe leaking.
3) Commode leaking at base.

Code 3 –Plumbing
Leaky faucets.

Code 3-Interior
1) Floors damaged.
2) Paint chipping or peeling.
3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is
occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)

No hot water in portion of building listed.

Code 3-All other work not listed above.

1.3.4 WARRANTY TAGS

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____. Address_____. Telephone number_____.

h. Warranty contact_____. Address_____. Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.4 MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Prior to final inspection and transfer of the completed facility; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems shall be submitted to and approved by the Contracting Officer as specified inapplicable technical specification sections.

1.5 OPERATION AND MAINTENANCE MANUALS

Three (3) copies of all Operation and Maintenance (O&M) manuals shall be submitted as follows:

AFGHANISTAN ENGINEER DISTRICT

(1) DHL, FEDEX, UPS or any other courier service:

U.S. Army Corps of Engineers

Afghanistan Engineer District

House # 1, St. #1 West

West Wazir Akbar High School

Behind Amani High School

Kabul, Afghanistan

Attn: Chief, Engineering Branch

Operation manuals and maintenance manuals shall be provided in a common volume, complete, clearly differentiated and separately indexed.

1.6 FINAL CLEANING

The premises shall be left broom clean. Stains, foreign substances, and temporary labels shall be removed from surfaces. Carpet and soft surfaces shall be vacuumed. Equipment and fixtures shall be cleaned to a sanitary condition. Filters of operating equipment shall be replaced. Debris shall be removed from roofs, drainage systems, gutters, and downspouts. Paved areas shall be swept and landscaped areas shall be raked clean. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed. A list of completed clean-up items shall be submitted on the day of final inspection.

-- END OF SECTION -

OPERATION AND MAINTENANCE DATA

1. GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01335 SUBMITTAL PROCEDURES.

1.1.1 PACKAGE QUALITY

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.2 PACKAGE CONTENT

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission.

1.1.3 CHANGES TO SUBMITTALS

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 OPERATING INSTRUCTIONS

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 SAFETY PRECAUTIONS

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 OPERATOR PRESTART

Include procedures required to set up and prepare each system for use.

1.2.1.3 STARTUP, SHUTDOWN, AND POST-SHUTDOWN PROCEDURES

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.2.1.4 NORMAL OPERATIONS

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 EMERGENCY OPERATIONS

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.2.1.6 OPERATOR SERVICE REQUIREMENTS

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.2.1.7 ENVIRONMENTAL CONDITIONS

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.2.2 PREVENTIVE MAINTENANCE

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 LUBRICATION DATA

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.2.2.2 PREVENTIVE MAINTENANCE PLAN AND SCHEDULE

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and

economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 CORRECTIVE MAINTENANCE (REPAIR)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.2.3.1 TROUBLESHOOTING GUIDES AND DIAGNOSTIC TECHNIQUES

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 WIRING DIAGRAMS AND CONTROL DIAGRAMS

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.2.3.3 MAINTENANCE AND REPAIR PROCEDURES

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.2.3.4 REMOVAL AND REPLACEMENT INSTRUCTIONS

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.4 CORRECTIVE MAINTENANCE WORK-HOURS

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 APPENDICES

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 PARTS IDENTIFICATION

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.2.6.1 WARRANTY INFORMATION

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 PERSONNEL TRAINING REQUIREMENTS

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.2.6.3 TESTING EQUIPMENT AND SPECIAL TOOL INFORMATION

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.6.4 CONTRACTOR INFORMATION

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

2. EXECUTION

2.1 TRAINING

Unless provided for elsewhere, the Contractor shall provide operational and maintenance training for all systems furnished under this contract in accordance with this section. The training shall not take place until the operation and maintenance manuals are submitted and approved.

Training will be given to personnel responsible for the operation and maintenance of the system at the installation. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in contractor provided activity personnel training. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Submit a training course schedule, syllabus, and training materials 14 days prior to the start of training. Obtain approval of the training course before beginning that phase of training. Furnish a qualified instructor approved by the system manufacturer to conduct training for the specific system.

Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education.

The Contractor shall videotape the training session on VHS tapes and provide the tapes to the Government.

-- END OF SECTION --

SECTION 02 41 00

DEMOLITION
10/06

PART 1 GENERAL

1.1 REFERENCES

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

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(2005) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2004) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	(June 2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	(2006; Notice 1) Requisitioning and Issue Procedures

MIL-STD-129	(Rev P; Notice 3) Military Marking for Shipment and Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K; Change 1) Obstruction Marking and Lighting

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

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

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

SD-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G
Notifications; G

Proposed salvage, demolition, and removal procedures for approval before work is started.

SD-11 Closeout Submittals

Receipts

Receipts or bills of laden, as specified.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6.

1.4.1 Notifications

1.4.1.1 General Requirements

Furnish timely notification of demolition projects to government authorities in accordance with 40 CFR 61, Subpart M. Notify the government environmental protection organization, local air pollution control district/organization and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

If unexpected asbestos/hazardous waste is encountered at the site, the Contracting Officer will investigate the conditions, determine the extent of the affected area, and authorize the Contractor, in writing, to remove and dispose of the asbestos/waste as directed and specified. Payment for such work will be made as specified in Contract. The Contractor will not be required to perform or arrange for this work

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.6.2 Existing Conditions Documentation

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 100 mm will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

1.6.3 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to be the property of the Government. Repair or replace damaged items if/as required by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports if/as required. Do not overload structural elements for government property.

1.6.4 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

1.6.5 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 1.8 m high fence. Erect and secure fence a minimum of 1.5 m from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.6.6 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of removal will be shut off by the Government and disconnected and sealed by the Contractor if/as required or directed.

1.6.7 Facilities

If/as required or directed, protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.6.8 Protection of Personnel

Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the work involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.9 REQUIRED DATA

Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, as applicable, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.10 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

1.11 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.12 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available at the notice-to-proceed.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures.

Fill material must conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material must be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 50 millimeter in any dimension.

Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures on site for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse on site whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to 1.2 meters below grade. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

d. Building, or the remaining portions thereof, not exceeding 25 m in height may be demolished by the mechanical method of demolition.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities as indicated or directed and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 7 m lengths and store in rolls off the ground.

3.1.4 Paving and Slabs

If/as directed, remove concrete and asphaltic concrete paving and slabs as indicated or as directed to a depth below existing adjacent or new finish grade. Provide neat sawcuts at limits of pavement removal. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored if/as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Roofing

As directed, salvage asphalt roofing materials.

3.1.6 Masonry

Masonry removed in whole blocks shall be salvaged and stored for reuse. Masonry removed in pieces shall be crushed for use as aggregate.

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 50 mm. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the concrete. Salvage removed concrete.

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated storage area, recycling facility or area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.10 Carpentry

Salvage for recycle lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse,

except stained, painted, or treated wood. Salvage windows, doors, frames, and cabinets, and similar items as whole units, complete with trim and accessories. Salvage hardware attached to units for reuse. Brace the open end of door frames to prevent damage.

3.1.11 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.12 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization.

3.1.13 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in Paragraph, "Salvaged Materials and Equipment".

3.1.14 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.15 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

3.1.16 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.16.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.16.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.16.3 Ducts

Classify removed duct work as scrap metal.

3.1.16.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify [non-porcelain] broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris and disposed of by the Contractor. Salvage and crush porcelain plumbing fixtures unsuitable for reuse.

3.1.17 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.17.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.17.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheated and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.17.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.17.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.18 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.1.19 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed within 10 km of the work site.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver items reserved as property of the Government to the areas designated as directed.

d. Remove as directed any items reserved as property of the using service prior to commencement of work under this contract.

e. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.3.3 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.3.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. Naval stock number (for information, call (804) 279-4525).

3.3.3.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.4 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.5 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in an approved disposal area off-site. The fill in the disposal area must remain below grade and after disposal is completed, the disposal area must be uniformly graded to drain.

3.4 CLEANUP

Remove debris and rubbish from excavations. Remove and transport the in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable government regulations as contractually specified off-site in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.5.2 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

SECTION 03 30 00.00 40

CAST-IN-PLACE CONCRETE
07/07

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 117	(2006) Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 211.1	(1991; R 2002) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(2005) Specifications for Structural Concrete
ACI 318/318R	(2005) Building Code Requirements for Structural Concrete and Commentary
ACI/MCP 205	(2005) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP 305	(2005) Manual of Concrete Practice Part 3:315-99 to 343R-95
ACI/MCP 405	(2005) Manual of Concrete Practice Part 4:345R-91(97) to 355.2R-04

ASTM INTERNATIONAL (ASTM)

ASTM A 615/A 615M	(2006a) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(2004) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2004a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 138/C 138M	(2001a) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	(2005a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 156	(2003) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2003) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2004) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2006) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2004) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2004) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 29/C 29M	(1997; R 2003) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 309	(2006) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2006) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying

ASTM C 618	(2005) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 70	(2006) Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 932	(2005) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM E 329	(2005b) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-2	(1998) Manual of Standard Practice

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1996) Construction and Industrial Plywood

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

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

Construction Equipment Lists shall be submitted by the Contractor prior to construction in accordance with the paragraph entitled, "General Information," of this section.

SD-03 Product Data

Manufacturer's catalog data for the following items shall include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Concrete Aggregates; G
Portland Cement; G
Ready-Mix Concrete; G
Form Facing Materials; G
Reinforcement Materials; G
Joint Materials; G
Concrete Curing Materials; G

SD-05 Design Data

Mix design data for each class of Ready-Mix Concrete shall be submitted at least 15 calendar days prior to start of specified work; G

SD-06 Test Reports

Reports for concrete shall be in accordance with the paragraph entitled, "Quality-Control Testing During Construction," of this section. Test reports of the chemical requirements of reinforcing bars shall also be submitted; G

Chemical Composition; G
Mechanical Usability; G
Soundness; G
Slump; G
Air Entrainment; G
Compressive Strength; G

SD-07 Certificates

Mill certificates shall be submitted for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Certificates for concrete shall be in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Certificates shall contain project name and number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results.

Concrete Design Mixes; G
Concrete Aggregates; G

SD-08 Manufacturer's Instructions

Installation instructions shall indicate the manufacturer's recommended method and sequence of installation for the following items:

Admixtures

SD-11 Closeout Submittals

Records of Communication shall be submitted in accordance with paragraph entitled, "General Information," of this section.

1.3 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Concrete testing shall be performed by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency shall meet the requirements of ASTM E 329.

1.4 CONCRETE SAMPLING AND TESTING

Testing by the Contractor shall include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Quality control testing during construction shall be performed by the Contractor.

Concrete aggregate materials proposed for use in the work shall be sampled and tested in accordance with ASTM C 33.

Portland cement shall be sampled and tested in accordance with ASTM C 150.

Air-entraining admixtures shall be sampled and tested in accordance with ASTM C 233.

1.5 CONCRETE DESIGN MIXES

Mix proportions for each concrete class shall be determined and tested as follows:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Specific gravity absorption of fine aggregate	ASTM C 128	As required for the concrete aggregate for each trial mix
Specific gravity and absorption of coarse aggregate	ASTM C 127	
Gradation of fine and coarse aggregates	ASTM C 117 and ASTM C 136	
Moisture content of both fine and coarse aggregates	ASTM C 70 and ASTM C 566	
Dry-rodded unit	ASTM C 29/C 29M	

weight of coarse aggregate		
Trial mixes using at least three different water/cement ratios, minimum allowable cement content, maximum allowable slump; both with and without air entrainment	ACI 211.1	As required to determine the concrete mix having the properties specified for each concrete class
Making and curing concrete specimens in the laboratory	ASTM C 192/C 192M	Two sets of three specimens for each design mix
Sampling fresh concrete in the laboratory	ASTM C 192/C 192M	One for each set of design mix specimens
Slump	ASTM C 143/C 143M	
Air content	ASTM C 231	
Yield	ASTM C 138/C 138M	
Compressive strength	ASTM C 39/C 39M	Three specimens tested at 7 days, and three specimens tested at 28 days for each mix design

Proportions of concrete mixtures shall be determined in accordance with ACI/MCP 205 and Method 1 of ACI 301, Section 3.8.2.1. Separate curves shall be prepared for air-entrained and nonair-entrained concretes.

1.6 DELIVERY AND STORAGE OF MATERIALS

Packaged materials shall be delivered to the project site in their original, unopened package or container bearing label clearly identifying manufacturer's name, brand name, material, weight or volume, and other pertinent information. Packaged materials shall be stored in their original, unbroken package or container in a weathertight and dry place until ready for use in the work.

Unpackaged aggregates shall be stored to avoid excessive segregation, contamination with other materials or other size aggregates, or freezing.

Reinforcement and other metal items shall be protected from corrosion and shall be kept free from ice, grease, and other coatings that would destroy or reduce bond.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

2.1.1 Concrete Aggregates

Fine and coarse aggregates shall conform to ASTM C 33.

2.1.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, IA, II, or IIA. One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces.

2.1.3 Admixtures

2.1.3.1 Air-Entraining Admixtures

Air-entraining admixtures shall conform to ASTM C 260.

2.1.3.2 Water-Reducing Admixtures

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

2.1.3.3 Pozzolan

Fly ash or other pozzolans used as admixtures shall conform to ASTM C 618, Class C or Class F with 4 percent maximum loss on ignition and 20 percent maximum cement replacement by weight.

2.1.4 Water

Water shall be potable.

2.2 READY-MIX CONCRETE

Concrete shall meet the requirements of ASTM C 94/C 94M.

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

Type and brand cement

Cement content in 43 kilogram bags per cubic meter of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3 FORM FACING MATERIALS

2.3.1 Concrete Form Plywood (Standard Rough)

Plywood shall conform to NIST PS 1, B-B, concrete form, not less than 16 millimeter thick.

2.3.2 Overlaid Concrete Form Plywood (Standard Smooth)

Plywood shall conform to NIST PS 1, B-B, high density form overlay, not less than 16 millimeter thick.

2.4 REINFORCEMENT MATERIALS

2.4.1 Reinforcing Bars

Reinforcing bars shall conform to ASTM A 615/A 615M and Supplemental S1, Grade 60, ACI/MCP 405, ACI/MCP 305 and ACI 318/318R, Section 3.5.3.2.;4218.0 kg./sq. cm yield strength.

2.4.2 Dowels for Load Transfer in Floors

Dowels for load transfer in floors shall be of the type, design, weight, and dimensions indicated. Dowel bars shall be plain-billet steel conforming to ASTM A 615/A 615M, Grade 40. Dowel pipe shall be steel conforming to ASTM A 53/A 53M.

2.4.3 Supports for Reinforcement

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

Supports shall be wire bar type conforming to ACI/MCP 405, ACI/MCP 305ACI 318/318R and CRSI MSP-2.

Legs of supports in contact with formwork shall be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports. When using epoxy-coated reinforcement bars, coat supports with same material.

2.4.4 Anchor Bolts

Anchor bolts shall conform to ASTM A307 using A36 steel.

2.5 JOINT MATERIALS

2.5.1 Preformed Joint Filler Strips

Filler strips shall be nonextruding and resilient nonbituminous type conforming to ASTM D 1752, Type I or II.

2.5.2 Joint Sealant Compound

Compound shall be cold-applied, two-component, elastomeric polymer type conforming to FS SS-S-200.

2.5.3 Bond Break Material

Bond Break shall be polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

2.6 CONCRETE CURING MATERIALS

2.6.1 Absorptive Cover

Cover for curing concrete shall be burlap cloth made from jute or kenaf, weighing 300 gram plus or minus 3 percent per square meter when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.6.2 Moisture-Retaining Cover

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

2.6.3 Water

Water shall be potable.

2.6.4 Membrane-Forming Curing Compound

Compound shall be liquid type conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.7 CLASSIFICATION AND QUALITY OF CONCRETE

2.7.1 Concrete Classes and Usage

Concrete classes, compressive strength, requirements for air entrainment, and usage shall be as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER MEGA pascal	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
3.5A	25	Air-entrained	For foundation concrete work exposed to freezing and thawing or subjected to hydraulic pressure, such as foundation walls, grade beams, pits, tunnels, concrete slabs, steps, platforms, walks

3.5N	25	Nonair-entrained	For foundation concrete work not exposed to freezing and thawing or subjected to hydraulic pressure, such as footings, pile caps, foundation mats. For interior slabs on ground including garage/vehicle maintenance slabs
4A	27.6	Air-entrained	For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels
4N	27.6	Nonair-entrained	For structural concrete work not exposed to freezing and thawing such as interior columns, beams, and supported slabs

2.7.2 Limits for Concrete Proportions

Limits for maximum water/cement ratio and minimum cement content for each concrete class shall be as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 75 TO 100 MM SLUMP, (NO. OF 43 KILOGRAM SACKS) PER .75 CU. METER
3.5A	0.48	5.62
3.5N	0.51	5.62

2.7.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, shall be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
50.8 mm	357	Nonreinforced footings and other flat work having a depth of not less than 6 inches, and nonreinforced walls and other formed sections having a dimension between forms of not less than 10 inches
38.1 mm	467	Monolithic slabs on ground, concrete fill, and other flat-work having a depth of not less than 5 inches and a clear

		distance between reinforcing bars of not less than 2 inches
19.1 mm	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and face of form of not less than 1 inch

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

2.7.4 Slump

Slump for concrete at time and in location of placement shall be as follows:

TYPE OF CONSTRUCTION	SLUMP
Footings, unreinforced walls	Not less than 25 millimeter nor more than 75 millimeter
Columns, beams, reinforced walls, monolithic slabs	Not less than 25 millimeter nor more than 100 millimeter
Ramps and other sloping surfaces	0 nor more than 75 millimeter

2.7.5 Total Air Content

Air content of exposed concrete and interior concrete shall be in accordance with ASTM C 260 and/or as follows:

LIMITS CONCRETE EXPOSURE	REQUIREMENT FOR AIR ENTRAINMENT	MAXIMUM SIZE OF AGGREGATE	TOTAL AIR CONTENT BY VOLUME
Exposed to freezing and thawing or subjected to hydraulic pressure	Air-entrained	38.1 or 69.9 mm	4 to 6 percent
			5 to 7 percent
		12.7 or 9.5 mm	6 to 8.5 percent

Concrete exposed to freezing and thawing or subjected to hydraulic pressure shall be air-entrained by addition of approved air-entraining admixture to concrete mix.

PART 3 EXECUTION

3.1 FORMWORK

3.1.1 General

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

3.1.2 Design and Construction of Formwork

Form work design and construction shall conform to ACI/MCP 205 and ACI 301, Chapter 4.

Forms shall be tight to prevent leakage of cement paste during concrete placing.

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

Exposed joints, edges, and external corners shall be chamfered a minimum of 19 millimeter by moldings placed in corners of column, beam, and wall forms.

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

Temporary openings shall be provided in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Forms shall be readily removable without impact, shock, or damage to concrete.

3.1.3 Forms for Standard Rough Form Finish

Rough form finish shall be given concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

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

For concrete surfaces exposed only to the ground, undressed, square-edge, 25 millimeter nominal thickness lumber may be used. Horizontal joints shall be level and vertical joints shall be plumb.

3.1.4 Forms for Standard Smooth Form Finish

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

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

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

Arrangement of form facing sheets shall be orderly and symmetrical, and sheets shall be in sizes as large as practical.

Panels shall be arranged to make a symmetrical pattern of joints. Horizontal and vertical joints shall be solidly backed and butted tight to prevent leakage and fins.

3.1.5 Form Ties

Ties shall be factory fabricated metal, adjustable in length, removable or snap-off type that will not allow form deflection or will not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts shall be at least 38 millimeterback from concrete surface. Form ties shall be free of devices that will leave a hole larger than 22 millimeter or less than 13 millimeter in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.1.6 Tolerances for Form Construction

Formwork shall be constructed to ensure that after removal of forms and prior to patching and finishing of formed surfaces, concrete surfaces shall be in accordance with tolerances specified in ACI 117 and ACI/MCP 205.

3.1.7 Preparation of Form Surfaces

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

3.1.8 Removal of Forms

Formwork that does not support weight of concrete, such as sides of beams, walls, columns, and similar vertical parts of the work, may be removed 24 hours after placing concrete, provided concrete is sufficiently hard not to be damaged from form-removal operations.

Formwork that supports weight of concrete, such as beam soffits, slabs, and similar horizontal parts of the work, shall remain in place at least until concrete has attained design minimum laboratory compressive strength at 28 days for applicable concrete class specified.

Form facing material may be removed before concrete has attained its required 28-day compressive strength but in no case less than 6 days after placing concrete, provided shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports. Shores and other vertical supports shall remain in place until concrete has attained its required 28-day compressive strength.

Results of control tests will be used as evidence that concrete has attained sufficient strength to permit removal of supporting forms. Test specimens shall be removed from molds at the end of 24 hours and stored in the structure as near points of sampling as possible; shall receive same protection from elements during curing as is given those portions of the structure which they represent; and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three-fourths of proposed period before removal of forms. Supporting forms of shoring shall not be removed until strength of control-test specimens has attained a value of at least 10.3 Megapascal for columns and 13.8 Megapascal for other work. Contractor shall ensure that newly unsupported portions of the structure are not subjected to heavy construction or material loading.

Tie-rod clamps to be removed from wall shall be loosened 24 hours after concrete is placed; form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward inside face.

When formwork is removed during concrete curing period, exposed concrete shall be cured as specified.

3.1.9 Re-Use of Forms

Surfaces of forms that are to be re-used shall be cleaned and repaired, except that split, frayed, or delaminated form facing material shall not be re-used. Contact surfaces of re-used forms shall be coated as specified.

3.2 REINFORCEMENT FABRICATION AND INSTALLATION

3.2.1 General

Details of reinforcement shall be in accordance with ACI/MCP 405, ACI/MCP 305 and ACI 318/318R, and as specified.

3.2.2 Fabrication

Reinforcing bars shall be shop fabricated to conform to shapes and dimensions indicated for reinforcement, and as follows:

Fabrication tolerances shall be in accordance with ACI/MCP 205, ACI/MCP 305, ACI 318/318R, and ACI 117.

Hooks and bends shall be in accordance with ACI/MCP 405, ACI/MCP 305 and ACI 318/318R.

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

Tolerance on nominally square-cut, reinforcing bar ends shall be in accordance with ACI/MCP 305 and ACI 318/318R.

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

Reinforcement which has any of the following defects shall not be used:

Bar lengths, depths, and bends beyond specified fabrication tolerances

Bends or kinks not indicated on drawings or approved shop drawings

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

Defective reinforcement shall be replaced with new reinforcement having required shape, form, and cross-section area.

3.2.3 Placing Reinforcement

Reinforcement shall be placed in accordance with ACI/MCP 405, ACI/MCP 305 and ACI 318/318R.

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

For slabs other than on grade, supports for which any portion will be less than 25 millimeter from concrete surfaces that will be exposed to view or will be painted shall be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units shall be wedge shaped, not larger than 90 by 90 millimeter, and of thickness equal to that indicated for concrete protection of reinforcement. Precast units shall have cast-in galvanized tie wire hooked for anchorage and shall blend with concrete surfaces after finishing is completed.

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

Reinforcement shall be supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Supports for reinforcing bars shall be sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP 405, ACI/MCP 305ACI 318/318R and CRSI MSP-2. Supports shall not be used to support runways for concrete conveying equipment and similar construction loads.

Supports on ground and similar surfaces shall be equipped with sand-plates.

Reinforcements shall be secured to supports by means of tie wire. Wire shall be black, soft iron wire, not less than 1.6 millimeter.

With the exception of temperature reinforcement, which shall be tied to main steel approximately 600 millimeter on center, reinforcement shall be accurately placed, securely tied at intersections with 1.3 millimeter annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Wire-tie ends shall point away from the form. Unless otherwise indicated, numbers, type, and spacing of supports shall conform to ACI/MCP 305and ACI 318/318R.

Bending of reinforcing bars partially embedded in concrete will be permitted only as specified in ACI/MCP 405, ACI/MCP 305 and ACI 318/318R.

3.2.4 Spacing of Reinforcing Bars

Spacing shall be as indicated. If not indicated, spacing shall be in accordance with the ACI/MCP 405, ACI/MCP 305 and ACI 318/318R.

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

3.2.5 Splices in Reinforcement

Splices shall be as indicated on the approved drawings.

3.2.6 Concrete Protection for Reinforcement

Concrete protection shall be in accordance with the ACI/MCP 405, ACI/MCP 305and ACI 318/318R. Concrete members at or below grade shall have a minimum concrete cover over 75 millimeter.

3.3 JOINTS

3.3.1 Construction Joints

Joints not indicated shall be made and located so as not to impair strength and appearance of the structure and shall be as approved. Construction joints shall be located as follows:

In walls at not more than 18.3 meter in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and

window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

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

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

In slabs on ground, so as to divide slab into areas not in excess of 111.5 square meter

Keyways at least 40 millimeter deep shall be provided in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

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

3.3.2 Isolation Joints in Slabs on Ground

Joints shall be provided at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Joints shall be filled with premolded joint filler strips 13 millimeter thick, extending full slab depth. Filler strips shall be installed at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 19 millimeter in depth where joint will be sealed with sealing compound and not less than 6 millimeterin depth where joint sealing is not required. Wood strip shall be removed after concrete has set. Contractor shall clean groove of foreign matter and loose particles after surface has dried.

3.3.3 Control Joints in Slabs on Ground

Joints shall be provided to form panels as indicated.

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

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

3.3.4 Sealing Joints in Slabs on Ground

Isolation and control joints which will not be covered with finish flooring material shall be sealed with joint sealing compound after concrete curing period. Groove shall be slightly underfilled with joint sealing compound to

prevent extrusion of compound. Excess material shall be removed as soon after sealing as possible.

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

3.4 INSTALLATION OF ANCHORAGE DEVICES

3.4.1 General

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

3.4.2 Placing Anchorage Devices

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

3.5 PREPARATIONS FOR CONCRETE PLACING

3.5.1 General

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

Standing water shall be removed without washing over freshly deposited concrete. Flow of water shall be diverted through side drains provided for such purpose.

3.5.2 Subgrade Under Foundations and Footings

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

3.5.3 Subgrade Under Slabs on Ground

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

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

Actual density of top 300 millimeter of subgrade soil material-in-place shall not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

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

Finish surface of drainage fill under interior slabs on ground shall not show deviation in excess of 6.4 millimeter when tested with a 3000 millimeter straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground shall be not more than 6.10 millimeter above or 30.50 millimeter below elevation indicated.

Subgrade or fill surface under exterior slabs on ground shall be prepared as specified for subgrade under foundations and footings.

3.5.4 Formwork

Formwork shall be complete and approved. Debris and foreign material shall be removed from interior of forms before start of concrete placing.

3.5.5 Edge Forms and Screed Strips for Slabs

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

3.5.6 Reinforcement and Other Embedded Items

Reinforcement, joint materials, and other embedded materials shall be secured in position, inspected, and approved before start of concrete placing.

3.6 CONCRETE CONVEYING

3.6.1 Transfer of Concrete At Project Site

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

3.6.2 Mechanical Equipment for Conveying Concrete

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

3.7 CONCRETE PLACING

3.7.1 Weather Limitations and Protection

Concrete shall not be placed when the ambient temperature of the atmosphere exceeds 32 degrees C unless an approved chemical retardant is used, nor when the ambient air temperature is below 5 degrees C, nor during rain, sleet, or snow, unless protection is provided.

When concrete is placed at 32 degrees C or hotter it shall be covered and kept continuously wet for a minimum of 48 hours.

Protection shall be provided during cold weather in accordance with ACI/MCP 205 and ACI 301.

During inclement weather, protection material shall be watertight to prevent entry of rain, sleet, or snow onto surfaces to receive concrete and into fresh concrete.

Protection materials shall be stored at project site for use in event of unforeseen weather changes after start of concrete placing operations.

3.7.2 General Placing Requirements

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

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

Concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials shall not be used. Use of retempered concrete will not be permitted. Rejected concrete shall be removed from the site.

3.7.3 Placing Concrete in Forms

Concrete placed in forms shall be deposited in horizontal layers not exceeding 600 millimeter.

Temporary spreaders in forms shall be removed when concrete placing has reached elevation of spreaders.

Concrete placed in forms shall be consolidated by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Vibrators shall be designed to operate with vibratory element submerged in concrete and shall maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Vibrating equipment shall be adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement shall not be permitted. Vibrators shall not be used to

transport concrete inside forms. Vibrators shall be inserted and withdrawn vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Vibrator shall not be inserted into lower courses of concrete that have begun to set. At each insertion, duration of vibration shall be limited to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Placing of concrete in supporting elements shall not be started until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.7.4 Placing Concrete Slabs

Concrete for slabs shall be placed and consolidated in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

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

Finish of slabs shall be as specified.

3.7.5 Bonding

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

Bonding of fresh concrete that has set shall be obtained as follows:

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

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

Cement grout coating shall consist of equal parts of portland cement and fine aggregate by weight with not more than 22.5 liter of water per sack of cement. Cement grout shall be applied with a stiff broom or brush to a minimum thickness of 1.6 millimeter. Fresh concrete shall be deposited before cement grout has attained its initial set.

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

3.8 FINISHING OF FORMED SURFACES

3.8.1 Repairing and Patching Defective Areas

Immediately after removal of forms, defective areas shall be repaired and patched with cement mortar.

Honeycomb, rock pockets, voids over 13 millimeter in diameter, and holes left by tie rods and bolts shall be cut out to solid concrete, but in no case to a depth of less than 25 millimeter. Edges of cuts shall be perpendicular to surface of concrete. Before placing cement mortar, area to be patched at least 150 millimeter adjacent thereto shall be cleaned, dampened with water, and brush coated with neat portland cement grout. Cement mortar for patching shall consist of one part standard portland cement to two parts fine aggregate passing 1.18 millimeter mesh sieve and as little water as necessary for handling and placing. Where concrete surface will be exposed to view, portland cement portion of cement mortar shall be a blend of white and standard portland cement so that when dry, cement mortar will match surrounding concrete in color. Cement mortar shall be compacted in place and struck off slightly higher than the surrounding surface. Holes extending through concrete shall be filled by means of a plunger type gun or other suitable device from unexposed face, using a stop held at exposed face to ensure complete filling.

3.8.2 Standard Rough Form Finish

Finish shall be the concrete surface having texture imparted by form facing material used, defective areas repaired and patched as specified, and fins and other projections exceeding 6 millimeter in height rubbed down with wood blocks.

3.8.3 Standard Smooth Finish

Finish shall be as-cast concrete surface as obtained with form facing material for standard smooth finish. Defective areas shall be repaired and patched as specified; and all fins and other projections on surface shall be removed.

3.8.4 Related Unformed Surfaces

Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck off smooth after concrete is placed and shall be finished to a texture matching that of adjacent formed surfaces. Final surface treatment on formed surfaces shall continue uniformly across adjacent unformed surfaces.

3.9 FINISHING OF SLABS

3.9.1 Scratch Finish

A scratch finish shall be given to slab surfaces that are to receive concrete floor topping, mortar setting beds, or other bonded, applied, cement, finish flooring material.

After placing concrete slabs, surface shall be plane to a tolerance not exceeding 6.4 millimeter in 600 millimeter or 3.2 millimeter for surfaces requiring subsequent tile finish when tested with a 600 millimeter straightedge placed on the surface at not less than two different angles. Surfaces shall be uniformly sloped to drains. After leveling, surface shall be roughened with stiff brushes or raked before final set.

3.9.2 Float Finish

A float finish shall be given to slab surfaces that are to receive trowel finish and other finishes as specified and to slab surfaces that are to be covered with membrane waterproofing, membrane roofing, or terrazzo.

After placing is completed, concrete shall not be worked further until ready for floating. Floating shall begin when water has disappeared, or when concrete mix has stiffened sufficiently to permit proper operation of a power-driven float, or when both conditions have occurred. Any surface water remaining shall be removed before floating. Surface shall then be consolidated with power-driven floats. Hand floating shall be used in locations inaccessible to power-driven floats. Trueness of surface shall be checked at this stage with a 3000 millimeter straightedge. Surface shall be plane to a tolerance not exceeding 6.4 millimeter in 3000 millimeter or 3.2 millimeter for surfaces requiring subsequent tile finish when tested with a 3000 millimeter straightedge placed on the surface at not less than two different angles. High spots shall be cut down and low spots shall be filled. Surfaces shall be uniformly sloped to drains. Immediately after completion of leveling, surface shall be refloated to a uniform, smooth, granular texture.

3.9.3 Trowel Finish

Finish shall be given to slab surfaces that are to be exposed to view, and to slab surfaces to be covered with resilient flooring, paint, or other finish coating system.

After completion of float finish as specified above, the surface shall receive a trowel finish. First troweling after completion of float finish shall be done by a power-driven trowel and shall produce a smooth surface which is free of defects but which may contain some trowel marks.

Additional trowelings shall be done by hand after surface has hardened sufficiently. Final troweling shall be started when a ringing sound is produced as trowel is moved over surface. Surface shall be consolidated by hand troweling operation. Finished surface shall be free of trowel marks, uniform in texture and appearance, and plane to a tolerance not exceeding 6.4 millimeter in 3000 millimeter or 3.2 millimeter for surfaces requiring subsequent tile finish when tested with a 3000 millimeter straightedge placed

on the surface in any direction.Surface defects of sufficient magnitude to show through floor covering shall be removed by grinding.

3.9.4 Non-Slip Broom Finish

Finish shall be given to surfaces of exterior concrete steps and platforms, and elsewhere where indicated.

Immediately after completion of trowel finish, surface shall be slightly roughened by brooming with a fiber-bristle brush in a direction transverse to that of main traffic.

3.10 CONCRETE CURING AND PROTECTION

3.10.1 General

Freshly placed concrete shall be protected from premature drying and cold or hot temperature and shall be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Initial curing shall start as soon as free water has disappeared from surface of concrete after placing and finishing. Concrete shall be kept moist for minimum 72 hours.

Final curing shall immediately follow initial curing and before concrete has dried. Final curing shall continue until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 10 degrees C has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Rapid drying at end of final curing period shall be prevented.

3.10.2 Curing Methods

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified and approved.

Moist curing:

Moisture curing shall be accomplished by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Absorptive cover shall be placed to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Cover shall be placed directly on concrete in widest practical width, with sides and ends lapped at least 75 millimeter. Cover shall be weighted to prevent displacement; tears or holes appearing during curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Curing compound shall be applied uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Second coat shall be applied in a direction at right angles to direction of first coat. Total coverage for two coats shall be not more than 5 square meter per liter of curing compound. Concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by method and at rate specified. Continuity of coating shall be maintained for entire curing period and damage to coating during this period shall be repaired immediately.

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

3.10.3 Curing Formed Surfaces

Curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces shall be accomplished by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, final curing of formed surfaces shall be accomplished by any of the curing methods specified above, as applicable.

3.10.4 Curing Unformed Surfaces

Initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, shall be accomplished by membrane curing.

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

Final curing of concrete surfaces to receive liquid floor hardener of finish flooring shall be accomplished by moisture-retaining cover curing.

3.10.5 Temperature of Concrete During Curing

When temperature of atmosphere is 5 degrees C and below, temperature of concrete shall be maintained at not less than 13 degrees C throughout concrete curing period or 7 degrees C when the curing period is measured by maturity. When necessary, arrangements shall be made before start of

concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 27 degrees C and above or during other climatic conditions which will cause too rapid drying of concrete, arrangements shall be made before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete shall be uniform and shall not exceed 3 degrees C in any 1 hour nor 28 degrees C in any 24-hour period.

3.10.6 Protection from Mechanical Injury

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

3.10.7 Protection After Curing

Finished concrete surfaces shall be protected from damage by construction operations.

3.11 QUALITY-CONTROL TESTING DURING CONSTRUCTION

Concrete shall be sampled and tested for quality control by the Contractor during the placement of the concrete as follows:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Sampling fresh concrete	ASTM C 172 except modified for slump per ASTM C 94/C 94M	As required for each test
Slump test	ASTM C 143/C 143M	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air content by pressure method	ASTM C 231	One for each set of compressive strength tests
Compression test specimens	ASTM C 31/C 31M	One set of six standard cylinders for each compressive strength test
Concrete temperature		Hourly when air temperature is 4.4 degrees C or below and 26.7 degrees C or

		above; each time a set of compression test specimens is made
Compressive strength test	ASTM C 39/C 39M	One set for each 115 cubic meter or fraction thereof of each concrete class placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days and one specimen retained in reserve for testing if required

Test reports for concrete for Chemical Composition, Mechanical Usability and Soundness shall be submitted by the Contractor meeting all design specifications as required by referenced standards within this section.

3.12 INSPECTION AND ACCEPTANCE PROVISIONS

3.12.1 Evaluation of Compressive Strength Tests

Concrete quality control test will be evaluated as specified.

Compressive strength tests will be considered satisfactory if the average of all sets of five consecutive compressive strength tests equal or exceed the 28-day design compressive strength, or if no individual compressive strength test (average of two cylinders) falls below the required 28-day design compressive strength by more than 350 kilopascal.

If compressive strength tests fail to meet minimum requirements specified, concrete represented by such tests will be considered deficient in strength and subject to provisions specified.

3.12.2 Strength of Concrete Structure

Strength of concrete structure in place will be considered deficient if it fails to comply with requirements which control strength of structure, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

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

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

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

Poor workmanship likely to result in deficient strength

3.12.3 Testing Concrete Structure for Strength

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

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

Cores shall be tested after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent will be more than superficially wet under service.

Cores shall be air dried, (16 to 27 degrees C with relative humidity less than 60 percent) for 7 days before test and shall be tested dry if concrete they represent will be dry under service conditions.

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

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

Core holes shall be filled solid with patching mortar and finished to match adjacent concrete surfaces.

Concrete work that is found inadequate by core tests shall be corrected in a manner approved by the Contracting Officer.

-- End of Section --

SECTION 04 20 00

MASONRY
10/06

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 318/318R	(2005) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(2005) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 530	(2005) Building Code Requirements for Masonry Structures Commentaries
ACI 530.1	(2005) Specification for Masonry Structures
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(2006a) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 82/A 82M	(2005a) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C 1019	(2005) 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 2001) Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C 129	(2006) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C 140	(2006) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 27	(1998; R 2002) Fireclay and High-Alumina Refractory Brick
ASTM C 270	(2006) Standard Specification for Mortar for Unit Masonry
ASTM C 315	(2002) Clay Flue Linings
ASTM C 476	(2002) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 578	(2006) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 593	(1985; R 2000) Fly Ash and Other Pozzolans for Use with Lime
ASTM C 62	(2005) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 641	(1998e1) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2005a) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 67	(2006) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 780	(2006) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2006a) Loadbearing Concrete Masonry Units

ASTM C 91	(2005) Masonry Cement
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM D 2000	(2006a) 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
ASTM E 119	(2007) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 514	(2004) Water Penetration and Leakage Through Masonry

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2006) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-03A	(2005) 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

Structural Masonry; G

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. 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.

SD-03 Product Data

Cold Weather Installation; G

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU)

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

Anchors, Ties, and Bar Positioners; G

Two of each type used.

Expansion-Joint Materials; G

One piece of each type used.

SD-05 Design Data

Pre-mixed Mortar; G
Unit Strength Method; G

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

SD-06 Test Reports

Efflorescence Test; G
Field Testing of Mortar; G
Field Testing of Grout; G
Prism tests; G
Masonry Cement; G
Fire-rated CMU; G

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G

Copies of masonry inspector reports.

SD-07 Certificates

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

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

Insulation

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

Contamination

SD-08 Manufacturer's Instructions

Masonry Cement

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.

SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

Take-Back Program

Documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, 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.

1.3.1 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. Prefabricated lintels shall be marked on top

sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.3.2 Reinforcement, Anchors, and Ties

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

1.3.3 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. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.4 STRUCTURAL MASONRY

1.4.1 Special Inspection

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 Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.4.2 Unit Strength Method

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

1.4.3 Seismic Requirement

In addition to design requirements of ICC IBC, the Contractor shall provide additional seismic reinforcement as detailed on the drawings

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 and additional locations where indicated.

1.5 QUALITY ASSURANCE

1.5.1 Appearance

Blocks and bricks shall be manufactured at one time and from the same batch.

1.5.2 Contamination

When using bricks containing contaminated soil, supplier shall certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants will be released, or that the product is free from hazardous contaminants.

1.5.3 Testing

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

1.5.4 Spare Vibrator

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

1.5.5 Bracing and Scaffolding

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

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. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.

b. Mortar joint widths shall be maintained as specified.

c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.

d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.

e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.

f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for all exterior work and for all nonvertical surfaces. Grade SW or MW shall be used in other brickwork. Average dimensions of brick shall be 90 mm thick, 57 mm high, and 190 mm long (standard), subject to the tolerances specified in ASTM C 62. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Refractory Brick

ASTM C 27, low-duty type.

2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Grade N. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.4 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond elsewhere.

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

2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification. Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates. Slag shall comply with ASTM C 989; Grade 80.

2.4.2 Flue Linings and Thimbles

ASTM C 315, free from fractures. Sizes and shapes shall be as indicated.

2.5 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type M, N and S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C 593.

2.6 MASONRY MORTAR

Type M mortar shall conform to ASTM C 270 and shall be used for foundation walls. Mortar Type S and N 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 N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type N or S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; approved commercial fire clay mortar (air setting refractory mortar such as "Sairset" from RHI Refractories) or refractory cement (calcium-aluminate) mortar for fire brick and flue liners; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. 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. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.6.1 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.

2.6.2 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

2.6.3 Cement

Portland cement shall conform to ASTM C 150, Type I. Masonry cement shall conform to ASTM C 91, Type S M. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume. Additives shall conform to requirements in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

2.6.4 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.

2.7 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.

2.7.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.7.2 Grout Barriers

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

2.8 BAR POSITIONERS

Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below.

2.8.1 Bar Positioners

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

2.9 REINFORCING STEEL BARS AND RODS

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

2.10 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.

2.11 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS, and

shall be penetrating with a maximum volatile organic compound (VOC) content of 600 grams/liter.

2.12 FLASHING

Flashing shall be as specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

a. 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.

PART 3 EXECUTION

3.1 PREPARATION

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

3.1.1 Hot Weather Installation

The following precautions shall be taken 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.

3.1.2 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, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection. Conform to ACI 530.1 for hot and cold weather masonry erection.

3.1.2.1 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.

3.1.2.2 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

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Each unit shall be adjusted to its final position while mortar is still soft and plastic. 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. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. 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.

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 and as noted for exterior and shearwalls, 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 other work if/as shown.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view. Lay fire brick by dipping each brick in a soft mixture of fire clay and water and then rubbing the brick into place with joints as thin as practicable or provide refractory mortar with joints not more than 10 mm thick.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.2.4.2 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.4.3 Chimneys

Construct chimneys of brick with clay flue linings of the sizes indicated. Extend flue linings from 300 mm below the smoke inlet to 100 mm above the chimney cap. Place thimbles as indicated, flush with inside of or up to 25 mm into the flue lining. Set linings in fire clay mortar or refractory mortar and fill and smooth the joints on the inside. Set each section of flue lining before surrounding brickwork reaches top of flue lining section below. Build brickwork around lining, and fill the space between lining and brickwork with grout. Do not cut linings after they are installed in chimney. Unless indicated otherwise, provide a chimney cap of air-entrained concrete. Slope cap to a minimum edge thickness of 50 mm and reinforce with two rings of No. 3 gage galvanized steel wire.

3.2.5 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
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	6 mm
Plus	13 mm

3.2.6 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.

3.2.7 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:

3.2.7.1 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.

3.2.7.2 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.

3.2.7.3 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.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

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

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 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.

3.2.10 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.

3.2.11 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.

3.2.12 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 MORTAR

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.

3.4 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.

3.4.1 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.

3.4.2 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.

3.5 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.

3.6 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.

3.6.1 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.

3.6.2 Horizontal Grout Barriers

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

3.6.3 Grout Holes and Cleanouts

3.6.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 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.

3.6.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 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.

3.6.4 Grouting Equipment

3.6.4.1 Grout Pumps

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

3.6.4.2 Vibrators

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

3.6.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in 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.

3.6.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 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.

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
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75

Notes:

(1) The actual grout space or cell dimension must 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.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.8 CONTROL JOINTS

Control joints shall be provided as indicated in accordance with 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 mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 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.

3.9 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 3 m and installed with a 6 mm gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 1.2 m, unless limited by wall configuration.

3.10 LINTELS

3.10.1 Lintels

All lintels shall be constructed as cast-in-place concrete as shown and reinforced with a minimum of two No. 13 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place and shall be located 13 mm above the bottom inside surface of the lintel unit.

3.11 SILLS AND COPINGS

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

3.12 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.12.1 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.

3.12.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm on centers vertically, and if applicable, not over 600 mm on centers horizontally.

3.13 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed 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.

3.13.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.13.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 mL trisodium phosphate and 30 mL laundry detergent to 1 L of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.14 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

3.15 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered 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.

3.16 TEST REPORTS

3.16.1 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.

3.16.2 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.

3.16.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled 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.

3.16.4 Prism Tests

At least one prism test sample shall be made for each 465 square meters of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ACI 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 10.3 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 shall be permitted.

3.17 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with IBC.

-- End of Section --

SECTION 04 43 00

STONE MASONRY AND CONCRETE PERIMETER WALL
10/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(2006a) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 1142	(1995; R 2001) Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 476	(2002) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 593	(1985; R 2000) Fly Ash and Other Pozzolans for Use with Lime
ASTM C 780	(2006) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM E 514	(2004) Water Penetration and Leakage Through Masonry

1.2 UNIT PRICES

1.2.1 Method of Measurement

Stone masonry and concrete wall will be measured by the number of linear meters in the completed structure, including the masonry, mortar, concrete footing, and concrete wall and the coping material complete in place and accepted. The quantity measured for payment shall not exceed that shown on the plans or as directed by the AE.

1.2.2 Payment

Stone masonry will be paid for at the contract unit price per linear meter for Stone Masonry and Concrete Wall.

1.3 SYSTEM DESCRIPTION

Provide the specified and indicated perimeter wall including materials (stone, mortar, concrete, reinforcement, metal pipe or tube, angle, concertina string, barbed wire, galvanized wire, sniper screen, and accessories) installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with this section except as modified elsewhere in this contract.

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-02 Shop Drawings

Stone Masonry; G

Drawings including plans and elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; and expansion joints. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Cold Weather Installation; G

Cold weather construction procedures.

SD-04 Samples

Stone; G

Construct a sample stone wall laid up in mortar and pointed, for approval of the AE. Each sample shall show examples of the specified

stone finishes, quality of the workmanship in preparing the stone and placing them, and pointing of the beds and joints, and shall be sufficient area to illustrate the distribution of both the coloring and the stone size. The sample wall shall contain at least one representative corner. The top shall be dressed to show how the stone will abut the cap. Upon approval of such a sample by the AE, it shall become the standard for stone masonry in the entire work. In general, the size of stone masonry sample wall shall not be less than 12 feet long and 6 feet high.

Samples of three stretcher and header type stones. Stones shall show the full range of quality, shape, color and texture. Submit sample of mortar with stone.

Anchors, Ties, and Bar Positioners; G

Two of each type used.

Expansion-Joint Materials; G

One piece of the type to be used.

Sealant - One sample with stone; G

SD-06 Test Reports

Efflorescence Test; G
Field Testing of Mortar; G
Field Testing of Grout; G

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G

Copies of masonry inspector reports.

SD-07 Certificates

Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Reinforcing Steel Bars and Rods
Admixtures for Masonry Mortar
Admixtures for Grout

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

1.5 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, 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 Stone

Cover and protect stone and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C 90.

1.5.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties 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. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.6 STONE MASONRY

1.6.1 Special Inspection

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the stone masonry work. Minimum qualifications for the masonry inspector shall be 5 years of stone 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 stone masonry inspector shall be present during sampling and placing of stone, placement of reinforcement (including placement of bars in footings and walls), (as applicable) inspection of grout space, immediately prior to grouting, and during grouting operations. The stone masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.7 QUALITY ASSURANCE

1.7.1 Appearance

Stone shall be from the same quarry or area.

1.7.2 Bracing and Scaffolding

Provide bracing and scaffolding necessary for stone masonry and concrete core wall work. Design bracing to resist wind pressure as required by applicable code.

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 CEMENT CONCRETE

Cement concrete shall conform to Section 03 30 00.00 40, CAST-IN-PLACE CONCRETE.

2.3 STONE

Stone for stone masonry walls shall consist of sound durable blasted or field stone free from seams, cracks and other structural defects and of an approved and satisfactory quality and shape.

The stone shall consist of angular blasted or field stones having straight edges without re-entrant angles. The faces shall be flat but not necessarily rectangular in shape.

Individual stone shall have, when set in the wall, no face dimension less than 200 millimeters. Stretchers shall have a depth in the wall at least 1 1/2 times the rise, and a length on the face at least twice the rise. Headers shall have a length on the face at least equal to the rise. Headers shall hold in the heart of the wall the same size as on the face and shall extend at least 300 millimeters more than the stretchers into the backing.

2.4 MASONRY MORTAR

Mortar Type S and N 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 N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate.

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. Use a water repellent mortar additive following the manufacturer's instructions.

2.4.2 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

2.4.3 Cement

Portland cement shall conform to ASTM C 150, Type I. Containers shall bear complete instructions for proportioning and mixing to obtain the required

types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume. Additives shall conform to requirements in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

2.4.4 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 or coarse. 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.

2.6 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.

2.7 REINFORCING STEEL BARS, RODS AND TIES

Reinforcing steel bars, rods and ties shall conform to ASTM A 615/A 615M, Grade 60. Steel tie wire minimum 9 gage steel wire or equivalent with hot tip galvanized finish meeting ASTM A82-97A.

2.8 EXPANSION-JOINT MATERIALS

Sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. Compressible filler shall comply to ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness shown; formulated from neoprene, urethane or PVC. Sealant shall be penetrating with a maximum volatile organic compound (VOC) content of 600 grams/liter.

2.9 CONCERTINA STRING AND BARBED WIRE SUPPORTING ARMS

Supporting arms for barbed wire shall be steel, complete with provisions for anchorage to posts and for attaching the concertina string and 3 rows of barbed wire to each arm. Supporting arms may either be attached to posts or integral with the post top weather cap.

Contractor shall provide a double V of two 45-degree arms for six strands of wire, one set for each post where barbed wire is indicated.

2.10 BARBED WIRE

Wire shall conform to ASTM A 116, ASTM A 121, ASTM A 390, ASTM A 702 and ASTM F 626, two-strand, 2.6 millimeter wire with 2.0 millimeter 4-point round barbs spaced 125 millimeter on center.

2.11 CONCERTINA STRING AND BARBED TAPE

Reinforced barbed tape, single coil, for fence toppings shall be fabricated from 430 series stainless steel with a hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A 176. The stainless steel strip shall be 0.6 mm thick by 25 mm wide before fabrication. Each barb shall be a minimum of 30.5 mm in length, in groups of 4, spaced on 102 mm centers. The stainless steel core wire shall have a 2.5 mm diameter with a minimum tensile strength of 9.68 MPa and shall be in accordance with ASTM A 478. Sixteen gauge stainless steel twistable wire ties shall be used for attaching the barbed tape to the barbed wire.

PART 3 EXECUTION

3.1 CEMENT CONCRETE

Concrete and reinforcement work for the footing, concrete core wall and cap shall be in accordance with the requirements of Section 03 30 00.00 40, CAST-IN-PLACE CONCRETE.

3.2 PREPARATION

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

3.2.1 Hot Weather Installation

The following precautions shall be taken 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 stone masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; stone 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.

3.2.2 Cold Weather Installation

Before erecting stone masonry when ambient temperature or mean daily air temperature falls below 4 degrees C or temperature of stone is below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection. Conform to ACI 530.1 for hot and cold weather masonry erection.

3.2.2.1 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.

3.2.2.2 Completed Stone Masonry and Stone 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.

3.2.3 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.

3.2.4 Loads

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

3.2.5 Surfaces

Concrete footer on which stone 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.

3.3 SHAPING STONES

Selected stone, roughly shaped to provide suitable faces, shall be used at all angles and ends of walls. All shaping of stone shall be done before the stone is laid in the wall. If a stone is loosened after the mortar has set, it shall be removed, the mortar cleaned off and the stone relaid in fresh mortar.

3.4 LAYING STONE

The stone shall be laid in two 200 mm wythes separated by 200 mm core concrete and the face pattern shall be of uniform appearance throughout. The stones shall decrease in size from bottom to top of wall. The stones shall be laid on horizontal beds parallel to the natural bed of the stone. The stone wythes shall be interconnected using wire tie connections at maximum 450 mm spacing in both directions. Vertical joints shall be broken by at least 150 millimeters and no vertical joint shall be located directly above or below a header. Each stone to be set in mortar shall be cleaned and thoroughly wetted before being set. They shall be set on full beds of mortar, and mortar joints shall be full and the stone settled in place before the mortar has set. The wall shall be compactly laid having all interior joints completely filled with suitable stones or spalls thoroughly bedded in mortar.

3.4.1 Placing Concrete Core

Place concrete core between stone masonry wythes in uniform lifts not to exceed 600 mm after stone masonry construction has cured minimum 72 hours.

3.4.2 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by applicable 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.

3.4.3 Vertical Reinforcement

Place reinforcement in accordance with Section 03 30 00.00 40.

3.4.4 Tolerances

Stone 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. 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 walls and arises	
In adjacent stone	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 caps 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 stone wall	
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
Variations in thickness of walls	
Minus	6 mm
Plus	13 mm

3.4.5 Cutting and Fitting

Cutting and fitting, including that required to accommodate the work of others, shall be done by stone masons using power stone masonry saws. Stone may be wet or dry cut. Wet cut stone, before being placed in the work, shall be dried to the same surface-dry appearance as uncut stone being laid in the wall. Cut edges shall be clean, true and sharp.

3.4.6 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:

3.4.6.1 Tooled Joints

As directed, joints in exposed exterior stone 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.

3.4.7 Joint Widths

Joint widths shall be as follows:

3.4.7.1 Stone Masonry

Stone shall have minimum 10 mm joints.

3.4.8 Embedded Items

Reinforcement and pipe sleeves or metal tubes and other items required to be built-in shall be embedded as the concrete work progresses. Reinforcement and pipe sleeves for metal tubes shall be fully embedded in the concrete. Pipe sleeves or metal tubes shall be fully embedded in concrete cap to accept the vertical reinforcement and support (V) arms.

3.4.9 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.

3.4.10 Stone Masonry Wall Intersections

Each wythe shall be masonry bonded at corners and elsewhere. Stone masonry walls shall be tied together at corners and intersections with proper corner construction.

3.5 MORTAR

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 as part of foundation work as shown and prior to stone mortar work. Vertical wall reinforcement shall extend to within 50 mm of top of cap and grouted inside embedded pipe sleeves or metal tubes as shown.

3.6.1 Positioning Bars

Vertical bars shall be accurately placed within the wall at the position and spacing indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and stone. 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. 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 PLACING GROUT

Wall space containing reinforcing bars may be filled with grout for full height of reinforcement in wall. 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 stone.

3.8 STONE WALL EXPANSION JOINTS

Stone wall expansion joints shall be provided and constructed as shown on the drawings. Compressible filler and sealant shall fill and seal joints. Joints shall be kept free of mortar and other debris.

3.9 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed. 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 any 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. Stone masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Stone masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.9.1 Stone Masonry Surfaces

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

3.10 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered 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 cap. 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 stone masonry in place shall be cleaned of loose mortar and foreign material.

3.11 BARBED WIRE SUPPORTING ARMS, CONCERTINA STRING AND BARBED WIRE

3.11.1 Installation

Barbed wire supporting arms, concertina string and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting V shaped arms shall be anchored to the posts. Concertina string and barbed wire shall be fixed and pulled as shown and attached to the arms with clips or other means that will prevent easy removal.

3.12 TEST REPORTS

3.12.1 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 stone and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.12.2 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.

3.12.3 Efflorescence Test

Stone shall be tested for efflorescence. Tests shall be scheduled 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.

-- End of Section --

SECTION 04 57 13

MASONRY WOOD STOVE
10/09

PART 1 GENERAL

1.1 REFERENCES

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 96	(2007) Ventilation Control and Fire Protection of Commercial Cooking Operations

NSF INTERNATIONAL (NSF)

NSF 2	(2008) Food Equipment

1.2 RELATED REQUIREMENTS

Sections 03 30 00 CAST-IN-PLACE CONCRETE, 04 20 00 MASONRY, 05 12 00 STRUCTURAL STEEL, 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS, and 09 66 16 TERRAZZO TILE apply to this section, with additions and modifications specified herein.

PART 2 PRODUCTS

2.1 MASONRY WOOD STOVE

2.1.1 Stove

Construction as follows:
- Concrete housekeeping pad
- Steel support angle and channel
- Firebrick
- Mineral wool
- Steel flue box
- Cast iron stove top
- Cast iron door with hinge and latch
- Cast iron door with hinge and latch and adjustable vent
- Cast iron open grate

2.1.2 Materials

Except as modified herein, provide materials for wood stove as per this Section and Sections 04 20 00 (firebrick/refractory brick, CMU), 03 30 00 (CIP concrete), 05 12 00 (support angles and channels), 05 50 00 (cast iron stove tip, doors and grate and steel flue box, steel ash tray and vent), and 09 66 16 (terrazzo tile). Provide quantities, physical dimensions, colors, and characteristics as specified and indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Construct wood stove encasement and chimney (Sections 04 20 00 Masonry, 05 50 00 Metal: Miscellaneous and Fabrications and 09 66 16 Terrazzo Tile) on concrete housekeeping pad (Section 03 30 00 Cast-in-place-Concrete) as per specifications and manufacturer's instructions. Field verify actual stove dimensions prior to fabrication of cast iron stove top, grate and doors.

3.2 FIELD QUALITY CONTROL

Conduct inspection and testing in the presence of the Contracting Officer to certify compliance with specified requirements, NFPA 96 and NSF 2. Affect repairs and retest until no deficiencies exist.

3.2.1 Field Inspection

Before and after installation, inspect wood stove and ancillary work for compliance with specified requirements.

3.2.2 Operation Tests

Upon completion but before final acceptance, perform wood stove operation tests to determine that components, including adjustable components, operate properly and in accordance with specified requirements.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 316	(1989) ASD Manual of Steel Construction
AISC 317	(1992; Reprint 1999) ASD Manual of Steel Construction, Vol II: Connections
AISC 325	(2005e13) Manual of Steel Construction
AISC 326	(2002) Detailing for Steel Construction
AISC 341	(2005; Supp 1) Seismic Provisions for Structural Steel Buildings
AISC 348	(2000) Structural Joints Using ASTM A325 or A490 Bolts
AISC 350	(2005) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary
AISC 810	(1997) Erection Bracing of Low-Rise Structural Steel Frames/Fisher and West
AISC FCD	(1995a) Quality Certification Program Description

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 108	(2003e1) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A 143/A 143M	(2003) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 500	(2003a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 514/A 514M	(2005) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2004a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2006) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 6/A 6M	(2006a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 618	(2004) Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(2004) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM C 1107/C 1107M	(2007) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM F 844	(2004) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2004) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting
SSPC Paint 25 Specification No. 25 Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand	(1997; 2004e1) Paint Cleaned Steel Type I and Type II
SSPC SP 3	(2004e1) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, complete and ready for use. Structural steel systems including materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 316 and AISC 317 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

Conform to AISC 316, AISC 317, AISC 360, AISC 303, and AISC 348, except as modified in this section.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for 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

Erection Plan, including description of temporary supports; G

Fabrication drawings including description of connections; G

SD-03 Product Data

Shop primer

Welding electrodes and rods

Non-Shrink Grout

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

AISC Quality Certification

Welding procedures and qualifications

1.5 AISC QUALITY CERTIFICATION

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

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details with structural analysis as to compliance to specified design loads, if/as directed, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.6.2 Certifications

1.6.2.1 Erection Plan

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

1.6.2.2 Welding Procedures and Qualifications

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

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

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 Structural Shapes for Use in Building Framing
Wide flange shapes, ASTM A 992/A 992M.

2.1.3 Structural Steel Tubing

ASTM A 500, Grade B; ASTM A 501.

2.1.4 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B, weight class STD (Standard) .

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel, Steel Pipe

2.2.1.1 Bolts

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

2.2.1.2 Nuts

ASTM A 563M, Grade A, heavy hex style, except nuts under M36 may be provided in hex style.

2.2.1.3 Washers

ASTM F 436 washers for ASTM A 325 bolts.

2.2.2 Foundation Anchorage

2.2.2.1 Anchor Bolts

ASTM A 307.

2.2.2.2 Anchor Nuts

ASTM A 563, Grade A, hex style.

2.2.2.3 Anchor Washers

ASTM F 844.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C 1107/C 1107M, with no ASTM C 827 shrinkage.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer). Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

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

2.6 FABRICATION

2.6.1 Markings

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

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, or surfaces within 13 mm of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C; or when the primer may be exposed to temperatures below 4 degrees C within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished

construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 0.05 mm except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 13 mm and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION**********

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category STD structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M.

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

3.2 ERECTION

Erection of structural steel shall be in accordance with the applicable provisions of AISC 316 or endorsement F of AISC FCD. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.
Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

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

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches.

Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

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

3.3.2 High-Strength Bolts

ASTM A 325 bolts shall be fully tensiored to 70 percent of their minimum tensile strength. Provide load indicator bolts or washers in all ASTM A 325M bolted connections. Direct tensiion indicator tichtening, shall be the only acceptable tighentening methods. Bolts shall be installed in connection holes andn initially brought to a snug tight fit. After the initial tightening procedure, bolts shall be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4 GAS CUTTING

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

3.5 WELDING

AWS D1.1/D1.1M, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A 514/A 514M steel. Do not stress relieve ASTM A 514/A 514M steel by heat treatment. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

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

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

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

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

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be

cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 FIELD QUALITY CONTROL

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

3.7.1 Welds

3.7.1.1 Visual Inspection

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

3.7.2 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

-- End of Section --

SECTION 05 30 00

STEEL DECKS
07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2006a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 108	(2003e1) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 570/A 570M	(1998) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

ASTM D 1149	(1999) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 746	(2004) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

STEEL DECK INSTITUTE (SDI)

SDI 30	(2001) Design Manual for Composite Decks, Form Decks, and Roof Decks
SDI DDMO3	(3rd Edition) Diaphragm Design Manual
SDI DDP	(1987; R 2000) Deck Damage and Penetrations
SDI MOC2	(2006) Manual of Construction with Steel Deck

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002; E 2004) Paint Specification No. 20 Zinc-Rich Coating Type I Inorganic and Type II Organic

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-01	Load Assumptions for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2007) 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Form Deck and Roof Deck Units

Cant Strips

Ridge and Valley Plates

Metal Closure Strips

SD-03 Product Data

Accessories

Metal Roof Deck Units

Galvanizing Repair Paint

Joint Sealant Material

Form Deck Units

Repair Paint

Welder Qualifications

Welding Equipment

Welding Rods and Accessories

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

Accessories

SD-05 Design Data

Deck Units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

. Welding Procedures

Wind Storm Resistance

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.3.2 Qualifications for Welding Work

Follows Welding Procedures in accordance with AWS D1.1/D1.1M. Test specimens shall be made in the presence of Contracting Officer and shall be tested by an approved testing laboratory at the Contractor's expense.

Submit qualified Welder Qualifications in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.3 Regulatory Requirements

1.3.3.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Bld Mat Dir, or listing as Class I construction in the FM P7825, and so labeled.

1.3.3.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding an uplift pressure of 5 kPa when tested in accordance with the uplift pressure test described in the FM DS 1-28 or as described in UL 580 and in general compliance with UFC 3-310-01.

1.3.4 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. Must not exceed the design live load. The maximum uniform distributed storage load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI SG-913.

1.5.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than 24 gn before coating, meeting the requirements of AISI SG-973, except as modified herein.

2.1.2 Steel Coating

ASTM A 653/A 653M designation Z275 galvanized, or ASTM A 792/A 792M designation AZ165, aluminum-zinc alloy. Apply coating to both sides of sheet.

2.1.3 Mixes

2.1.3.1 Galvanizing Repair Paint for Floor Decks

Provide a high-zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A 780.

2.1.4 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A 36/A 36M, merchant quality, Grade Designation SAE/AISI 1023 or SAE/AISI 1025, and hot-dip galvanized in accordance with ASTM A 123/A 123M.

2.1.5 Joint Sealant Material for Roof Decks

Provide a nonskinning, gun-grade, bulk compound material as recommended by the manufacturer.

2.1.6 Galvanizing Repair Paint for Roof Decks

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel and shall conform to ASTM A 780.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.75 mm thick to close open ends at exposed edges of floors,end walls, eaves, and openings through deck.

2.2.3 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.4 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 1.204 mm; welding washers, 1.519 mm cant strip, 0.749 mm other metal accessories, 0.909 mm unless otherwise indicated. Accessories must include but not be limited to saddles, welding washers, fasteners, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

2.3 FABRICATION

Furnish one sample of each type of Form Deck Units used to illustrate the actual cross section dimensions and configuration.

Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

2.3.1 Roof Deck

Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A 653/A 653M, G90 galvanized coating class or aluminum-zinc coated in accordance with ASTM A 792/A 792M Coating Designation AZ55.

2.3.1.1 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.91 millimeter thick before galvanizing. Bend strips to form a 45-degree cant not less than 125 millimeter wide, with top and bottom flanges a minimum 75 millimeter wide. Length of strips 3000 millimeter.

2.3.1.2 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.91 millimeter thick before galvanizing. Provide plates of minimum 120 millimeter wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 3000 millimeter.

2.3.1.3 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.91 millimeter thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.3.2 Form Deck

Conform to ASTM A 653/A 653M or ASTM A 1008 for deck used as formwork for concrete. Fabricate form deck of the steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A 653/A 653M, G90 coating class.

2.3.3 Venting

To ensure positive venting from the underside, provide slotted or perforated steel deck to receive concrete fill, overlay, or a poured concrete deck.

2.3.4 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

2.3.5 Touch-Up Paint

Provide touch-up paint for shop-painted units of the same type used for the shop painting, and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the form decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage. Prepare shoring in position before concrete placement begins form deck.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding or mechanical attachment as indicated on the design drawings and in accordance with manufacturer's recommended procedure. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1/D1.1M and AWS D1.3 make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Lap 50 mm deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A 780 finish with the manufacturer's standard touch-up paint.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings 150 to 300 mm across by 1.204 mm (0.0474 inch) thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Reinforce holes and openings larger than 300 mm by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer

shall approve holes or openings larger than 150 mm in diameter prior to drilling or cutting.

3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.5 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of SDI 30.

3.3 JOINT SEALING FOR ROOF DECKS

Seal sidelaps and endlaps with manufacturer's recommended joint sealing material. Shop or field apply the material. Before applying the sealing material, completely remove dust, dirt, moisture, and other foreign material from the surfaces to which the sealing material is to be applied. Apply sealing material in strict accordance with the sealing material manufacturer's printed instructions.

3.4 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 300 millimeter. Lap end joints a minimum 75 millimeter and secure with galvanized sheet metal screws spaced a maximum 100 millimeter on center.

3.5 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 75 millimeter. For valley plates, provide endlaps to be in the direction of water flow.

3.6 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.7 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.9 FIELD QUALITY CONTROL

3.9.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 2 mm; when gap is more than 2 mm, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973	(2002) Cold-Formed Steel Design Manual
AISI SG02-1	(2001) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1998) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2006a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 1011/A 1011M	(2006b) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 370	(2006) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 653/A 653M	(2006a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e1) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 955	(2006) 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	(2005b) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J78	(1998) Steel Self Drilling Tapping Screws

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; 2004e1) Paint Specification No. 25Zinc 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 Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

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 A 370.

Welds

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

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 as applicable and as indicated, 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 SG-973. Non-load-bearing metal framing, furring, and ceiling suspension systems are specified in Section 09 22 00 METAL SUPPORT ASSEMBLIES.

1.5 MAXIMUM DEFLECTION

a. Exterior Studs:

Deflection Criteria	Exterior Finish
L/240 or L/360	Synthetic Plaster, Metal Panels
L/360	Cement Plaster, Wood Veneer
L/600	Brick Veneer, Stone Panels

Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 6 mm maximum deflection.

b. Floor Joists:

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

c. 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 A 653/A 653M, SS Grade 50.

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 A 653/A 653M, SS, Grade 345 230 MPa Z180<ENG> G60</ENG>; or carbon steel, ASTM A 1008/A 1008M, 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 ICBO 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 in compliance with SAE J78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

2.4 PAINT

Ungalvanized steel, if used, shall be thoroughly cleaned, phosphate treated, and coated with corrosion-inhibiting primer, SSPC Paint 25.

2.5 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, as modified by AISI SG02-1. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3. 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 of the self-drilling self-tapping type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-1. 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 SG-973, 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 00

METAL: MISCELLANEOUS AND FABRICATIONS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 350	(2005) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)
ASME B18.21.1	(1999; R 2005) Lock Washers (Inch Series)
ASME B18.21.2M	(1999; R 2005) Lock Washers (Metric Series)
ASME B18.22.1	(1965; R 2003) Plain Washers
ASME B18.22M	(1981; R 2005) Metric Plain Washers
ASME B18.52.1	(1996; R 2005) Square and Hex Bolts and Screws Inch Series
ASME B18.6.2	(1998; R 2005) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2003) Machine Screws and Machine Screw Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 240/A 240M	(2009a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 278/A 278M	(2001; R 2006) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C)
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 319	(1971; R 2006) Standard Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 500	(2003a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 666	(2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2004) Alkyd Anti-Corrosive Metal Primer

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2006; Errata 2006) Standard for Portable Fire Extinguishers
NFPA 101	(2006) Life Safety Code, 2006 Edition
NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2004e1) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 103	(2006) Standard for Safety for Factory-Built Chimneys for Residential Type and Building Heating Appliances

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

Fabrication drawings of structural steel door frames; G

Access doors and panels, installation drawings; G

Cover plates and frames, installation drawings; G

Expansion joint covers, installation drawings; G

Floor gratings and exterior stair trends, and landings installation drawings; G

Handrails, installation drawings; G

Ladders, installation drawings; G

Embedded angles and plates, installation drawings; G

Metal Window Sills, Installation Drawings; G

Steel Corner Guards, Installation Drawings; G

Stainless Steel Back Splash, Installation Drawings; 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; G

Access doors and panels; G

Cover plates and frames; G

Control-joint covers; G

Expansion joint covers; G

Handrails; G

Ladders; G

Steel stairs; G

Window sub sill; G

Cast iron plate for wood stove top; G

Cast iron grid plate for wood stove fire box; G

Cast iron insert for wood stove; G

Cast iron hinged cleanout door for wood stove; G

Cast iron sliding fire box door for wood stove; G

Structural steel door frames; G

Window and door guards; G

Roof hatch

Floor hatch

Steel corner guard

Stainless steel back splash

SD-04 Samples

Expansion joint covers

Control-joint covers

Steel corner guards

Stainless steel back splash

Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

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 A 36/A 36M.

2.1.2 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B.

2.1.3 Floor Plates, Patterned

Floor plate ASTM A 786/A 786M. Steel plate shall not be less than 1.9 mm.

2.1.4 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.4.1 Lag Screws and Bolts

ASME B18.52.1, type and grade best suited for the purpose.

2.1.4.2 Toggle Bolts

ASME B18.52.1.

2.1.4.3 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.4.4 Powder Driven Fasteners

Follow safety provisions of ASSE A10.3.

2.1.4.5 Screws

ASME B18.52.1, ASME B18.6.2, and ASME B18.6.3.

2.1.4.6 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.

2.1.5 Stainless Steel Back Splash

ASTM A240 A or ASTM A666 (Type 304)

2.1.6 Cast Iron

ASTM A 319, Class III.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, 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 A 780 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. 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.

2.3 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 600 by 600 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 CONTROL-JOINT COVERS

Provide control-joint covers to be located on wall surfaces of concrete, masonry and tile work. Provide protective coating on the surface in contact with concrete, masonry or tile.

2.5 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide extra strong weight steel pipe as specified in ASTM A 53/A 53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 21 MPa.

2.6 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.

2.7 MISCELLANEOUS PLATES AND SHAPES

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

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

2.8 CHIMNEYS, VENTS, AND SMOKESTACKS

Chimneys and vents shall be designed and constructed in accordance with NFPA 211 and UL 103 HT (stainless steel vent). Chimney connectors shall be formed of not lighter than 1.01 mm (20 gauge) galvanized steel. Stacks shall be designed and constructed to withstand a wind velocity as indicated on the structural drawings. Seams and joints shall be welded, except that an angle flange shall be provided for connection to equipment, and stack support.

2.9 CLEANOUT DOORS

Cleanout doors shall be cast iron, shall be provided with frames, and unless otherwise indicated, shall be sized to match flues. The frames shall have a continuous flange and anchors for securing into masonry. The doors shall be smokeproof, hinged, and shall have fastening devices to hold the door closed.

2.10 STOVE PLATES , GRATES AND DOORS

Stove plates and doors shall be cast iron and configured for wood burning stove. The doors shall have fastening devices to hold the doors closed.

2.11 WINDOW SUB-SILL

Window sub-sill shall be of galvanized steel alloy of 1 mm (20 gage) and design indicated. Not less than two anchors per window section shall be provided for securing into mortar joints of masonry sill course. The metal window sills shall have a turn down of 50 mm over the exterior masonry and stucco. Metal sills shall extend from side to side of the masonry opening in a single piece. Sills for banks of windows shall have standard mill finish with a protective coating, prior to shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

2.12 ALUMINUM SILL

Aluminum sill enclosures shall be extruded at 20 gage and dimensions and profile as required and indicated.

2.13 STAINLESS STEEL BACK SPLASH

Stainless steel back splash at propane stove shall be 18' gage with #4 brushed finish, and dimensions and profile as required and indicated.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.Items listed below require additional procedures.

3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners,

when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

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

3.5 WELDING

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

3.6 FINISHES

3.6.1 Dissimilar Materials

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

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 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

3.9 HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.9.1 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 or by means of pipe sleeves secured to masonry with expansion shields and bolts or toggle bolts or 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.

3.10 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 over 1200 mm on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon floor.

3.11 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.12 INSTALLATION OF CHIMNEYS, VENTS, AND SMOKESTACKS

Chimneys and vents shall be installed in accordance with NFPA 211 and UL 103 HT. A cleanout opening with a tight-fitting, hinged, cast-iron door and frame shall be provided at the base of each smokestack. As applicable, a top band shall be provided on stacks for attachment of painter's rigging. Roof housing, rain cap, downdraft diverter, fire damper, and other accessories required for a complete installation shall be provided. Sections of prefabricated lined stacks shall be joined with acid-resisting high-temperature cement and steel draw bands. Means to prevent accumulation of water in the smokestack shall be provided.

3.13 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

3.14 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.15 INSTALLATION OF METAL WINDOW SUB-SILL

Extend the metal window sill a minimum of 20 mm under the bottom of the aluminum windows. Install masonry mortar under the metal sub-sill as required for a smooth surface under the window sills. Sills shall slope a minimum of 6 mm to the exterior and not allow water to puddle.

3.16 INSTALLATION OF STAINLESS STEEL BACK SPLASH

Attach to surface with stainless steel screws.

3.17 INSTALLATION OF PROPANE STOVE STEEL CORNER GUARDS

Weld miter corners, attach to surface with 6 mm anchors, 300 mm or center, minimum 2 anchors per angle, as indicated.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS
04/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 180	(2000; R 2004) Corrugated Sheet Steel Beams for Highway Guardrail
AASHTO M 314	(1990; R 2004) 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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 2003) Plain Washers
ANSI B18.22M	(1981; R 2005) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.3.8M	(1981; R 2005) Metric Hex Lag Screws
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts
ASME B18.6.7M	(1999; R 2005) Metric Machine Screws

ASTM INTERNATIONAL (ASTM)

ASTM A 108	(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2008) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(2003; R 2007) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 449	(2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 467/A 467M	(2007) Standard Specification for Machine Coil and Chain
ASTM A 47/A 47M	(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 500/A 500M	(2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 512	(2006) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 575	(1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM B 221	(2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

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 B 429/B 429M	(2006) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 514	(2004) 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

INDUSTRIAL FASTENERS INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws

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) Paint Specification No. 25Zinc 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

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

Steel Railings and Handrails

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

Cold Finished Steel Bars

Hot-Rolled Carbon Steel Bars

Cold-Drawn Steel Tubing

Concrete Inserts

Masonry Anchorage Devices

Protective Coating

Steel Railings and Handrails

SD-07 Certificates

Submit Welding Procedures in accordance with AWS D1.1/D1.1M.

Submit certificates for Welder Qualification in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

SD-08 Manufacturer's Instructions

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair work.

Structural Steel Plates, Shapes, and Bars

Structural Steel Tubing

Cold Finished Steel Bars

Hot-Rolled Carbon Steel Bars

Cold-Drawn Steel Tubing

Protective Coating

Masonry Anchorage Devices

Steel Railings and Handrails

1.3 QUALIFICATIONS FOR WELDING WORK

Provide Welding Procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

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

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Provide 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.

Preassemble 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, except plates to be bent or cold-formed, must conform to ASTM A 36/A 36M, unless otherwise noted.

Steel plates to be bent or cold-formed must conform to ASTM A 283/A 283M, Grade C.

Steel bars and bar-size shapes must conform to ASTM A 36/A 36M, unless otherwise noted.

2.3 STRUCTURAL STEEL TUBING

Structural steel tubing, hot-formed, welded or seamless, must conform to ASTM A 500/A 500M, Grade B, unless otherwise noted.

2.4 HOT-ROLLED CARBON STEEL BARS

Bars and bar-size shapes must conform to ASTM A 575, grade as selected by the fabricator.

2.5 COLD-FINISHED STEEL BARS

Bars must conform to ASTM A 108, grade as selected by the fabricator.

2.6 COLD-DRAWN STEEL TUBING

Tubing must conform to ASTM A 512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.7 STEEL PIPE

Pipe must conform to ASTM A 53/A 53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.8 CONCRETE INSERTS

Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with ASTM A 153/A 153M. Provide slotted-type concrete inserts consisting of galvanized 3 millimeter thick pressed steel plate conforming to ASTM A 283/A 283M; they must be 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 A 123/A 123M.

2.9 MASONRY ANCHORAGE DEVICES

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

Provide 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.

2.10 FASTENERS

Galvanize zinc-coated fasteners in accordance with ASTM A 153/A 153M 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 bolts and nuts must be regular hexagon-head conforming to ASTM F 568M.

Lag bolts must be square-head conforming to ASME B18.2.3.8M.

Machine screws cadmium-plated steel conforming to ASME B18.6.7M.

Wood screws must be flat-head carbon steel conforming to IFI 502.

Plain washers must be round, general-assembly-grade, carbon steel conforming to ANSI B18.22M.

Lockwashers must be helical spring, carbon steel conforming toASME B18.2.3.8M.

2.11 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 than1 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. Exposed edges must be 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. Grid 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.

2.12 PROTECTIVE COATING

Shop prime 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, and surfaces of crane rails.]

Provide hot dipped galvanized steelwork as indicated in accordance with ASTM A 123/A 123M. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.13 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.

2.13.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength. Provide steel railings of 40 mm nominal size. Railings to be hot-dip galvanized and shop painted.

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 mmhexagonal-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.

Provide kickplates between railing posts where indicated, and consist of 4 millimeter steel flat bars not less than 150 millimeter high. Secure kickplates as indicated.

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 STAIR RAILINGS AND HANDRAILS

Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 2440 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 sleeved; closure must be of width and length not less than 25 millimeter greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, the annular space between post and sleeve must be filled 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 toeboards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.2 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. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts.

3.3 FIELD WELDING

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

3.4 TOUCHUP PAINTING

Immediately after installation, clean field welds, bolted connections, and 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 06 10 00

ROUGH CARPENTRY
07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T10	(2001) Wood Frame Construction Manual for One- and Two-Family Dwellings
AF&PA T101	(2001) National Design Specification (NDS)for Wood Construction

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111	(2005) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection
AITC A190.1	(2002) Structural Glued Laminated Timber
AITC OT-01	(2004) Timber Construction Manual

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E30	(2005) Engineered Wood Construction Guide
APA E445S	(2001; R 2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA EWS R540C	(1995; R 1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA EWS T300E	(2005) Technical Note: Glulam Connection Details
APA F405L	(1999) Performance Rated Panels
APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood
APA PS 2	(2004) Voluntary Product Standard for Wood-Based Structural-Use Panels

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts
ASME B18.52.1	(1996; R 2005) Square and Hex Bolts and Screws Inch Series
ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM C 1136	(2006) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM D 6112	(1997) Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 1667	(2003) Driven Fasteners: Nails, Spikes, and Staples
ASTM F 547	(2001) Nails for Use with Wood and Wood-Base Materials

FM GLOBAL (FM)

FM DS 1-49	(2000) Perimeter Flashing

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2006) International Building Code

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2003) Standard Grading Rules for Northeastern Lumber

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923	(Rev A; Notice 1) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 1) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 1) Shield Expansion (Nail Anchors)
FS FF-B-588	(Rev E) Bolt, Toggle: and Expansion Sleeve, Screw
FS FF-T-1813	(Basic) Tack
FS MM-T-371	(Rev E) Ties, Railroad, Wood (Cross and Switch)
FS UU-B-790	(Rev A) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(2000) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5	(1998) Western Lumber Grading Rules

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for 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

Nailers and Nailing Strips

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Adhesives

Submit manufacturer's product data, indicating VOC content.

SD-07 Certificates

Certificates of grade

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Preservative treatment

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA PS 1.Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.5 SIZES AND SURFACING

APA PS 20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and boards - 19 percent maximum

b. Timbers 125 mm and thicker - 25 percent maximum

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Virgin Lumber

Lumber fabricated from old growth timber is not permitted. Avoid companies who buy, sell, or use old growth timber in their operations, when possible.

2.1.2 Recovered Lumber

Use recovered lumber where practical. Unless otherwise noted, recovered lumber shall be delivered clean and free of contamination. Provide grading certificates for any recovered wood materials used in structural applications.

2.2 PLYWOOD PANELS

APA PS 1, APA PS 2, APA E445S, and APA F405L respectively.

2.2.1 Exposed Exterior Canopy Ceiling Sheathing

2.2.1.1 Plywood

C-D Grade, Exposure 1, with an Identification Index of not less than 24/0.

2.3 OTHER MATERIALS

2.3.1 Building Paper

FS UU-B-790, Type I, Grade D, Style 1.

2.4 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

2.4.1 Bolts, Nuts, Studs, and Rivets

ASME B18.52.1, ASME B18.5.2.1M, ASME B18.5.2.2M, ASME B18.2.2, and ASTM A 687.

2.4.2 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.4.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 10 mm.

2.4.4 Lag Screws and Lag Bolts

ASME B18.52.1.

2.4.5 Toggle Bolts

FS FF-B-588.

2.4.6 Wood Screws

ASME B18.6.1.

2.4.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 25 mm into supports. In general, 8-penny or larger nails shall be used for nailing through 25 mm thick lumber and for toe nailing 50 mm thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgment backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.4.8 Wire Nails

ASTM F 1667.

2.4.9 Tacks

FS FF-T-1813.

2.4.10 Clip Angles

Steel, 5 mm thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AF&PA T10 and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value

Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Provide adequate support as appropriate to the application, climate, and modulus of elasticity of the product. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Provide 50 mm minimum clearance between chimneys and wood framing; provide 100 mm minimum clearance at fireplaces. Fill the spaces with strips of approved noncombustible material.

3.1.1 Plywood and Structural-Use Panel Sheathing

Install with the grain of the outer plies or long dimension at right angles to supports. Stagger end joints and locate over the centerlines of supports. Allow 3 mm spacing at panel ends and 6 mm at panel edges. Nail panels with 8-penny common nails or 6-penny annular rings or screw-type nails spaced 150 mm o.c. at supported edges and 300 mm o.c. at intermediate bearings. Where the support spacing exceeds the maximum span for an unsupported edge, provide adequate blocking, tongue-and-groove edges, or panel edge clips, in accordance with APA E30.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

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

3.2.1.1 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 150 mm wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM DS 1-49. Strips shall be grooved as indicated for edge venting; install at walls, curbs, and other vertical surfaces with a 6 to 12 mm air space.

3.2.1.2 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curbs and at expansion joints, as necessary and of lumber or 19 mm thick exterior plywood.

3.2.2 Rough Wood Bucks

Size as indicated. Set wood bucks true and plumb. Anchor bucks to concrete or masonry with steel straps extending into the wall 200 mm minimum. Place anchors near the top and bottom of the buck and space uniformly at 600 mm maximum intervals.

3.2.3 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.4 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 2400 mm straightedge.

3.2.5 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.6 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified in Section 04 20 00, "MASONRY". Forms and centering for cast-in-place concrete work are specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

-- End of Section --

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 1004	(2003) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1149	(1999) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 1204	(2002) Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 146	(2004) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D 2136	(2002e1) Coated Fabrics - Low-Temperature Bend Test
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 297	(1993; R 2006) Rubber Products - Chemical Analysis
ASTM D 3045	(1992; R 2003) Practice for Heat Aging of Plastics Without Load
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 412	(1998a; R 2002e1) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 429	(2003e1) Rubber Property-Adhesion to Rigid Substrates
ASTM D 471	(2006) Standard Test Method for Rubber Property - Effect of Liquids

ASTM D 5385	(1993; R 2000e1) Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM D 570	(1998; R 2005) Standard Test Method for Water Absorption of Plastics
ASTM D 573	(2004) Standard Test Method for Rubber - Deterioration in an Air Oven
ASTM D 624	(2000e2) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 638	(2003) Standard Test Method for Tensile Properties of Plastics
ASTM D 746	(2004) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 751	(2006) Coated Fabrics
ASTM D 903	(1998; R 2004) Peel or Stripping Strength of Adhesive Bonds
ASTM E 154	(1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 96	(2005) 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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Elastomeric waterproofing sheet material

Protection board

Primers, adhesives, and mastics

SD-04 Samples

Materials

Submit material samples shwoing resolution of corner and field conditions.

SD-06 Test Reports

Elastomeric waterproofing sheet material

Certify compliance with performance requirements specified herein.

SD-08 Manufacturer's Instructions

Submit Manufacturer's material safety data sheets for primers, adhesives and mastics.

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawing Requirements

Include description and physical properties; termination details; application details; recommendations regarding shelf life, application procedures; requirements for protective covering; and precautions for flammability and toxicity.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Do not permit uncertified materials in the work area.

1.5 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing and when ambient and surface temperatures are 4 degrees C or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 4 degrees C will be waived if the Contractor devises a means, approved by the Contracting Officer, of maintaining the surface and ambient temperatures above 4 degrees C.

PART 2 PRODUCTS

2.1 MATERIALS

Provide one of the types of elastomeric waterproofing sheet materialand related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials within a specific type, with each other, and with the materials on which they will be applied. Materials shall conform to the applicable performance requirements cited below when tested in accordance with the referenced ASTM publications.

2.2 BUTYL RUBBER SHEETING

Not less than 1.5 mm minimum thickness.

2.2.1 Butyl Rubber Sheeting Performance Requirements

a. Thickness Tolerance, ASTM D 412: Plus or minus 10 percent;

b. Specific Gravity, ASTM D 297: 1.20, plus or minus 0.05;

c. Tensile Strength, ASTM D 412: 7.7 MP aminimum;

d. Tensile Stress at 300 percent elongation, ASTM D 412: 3.85 MPa minimum;

e. Elongation, ASTM D 412: 300 percent minimum;

f. Tear Resistance, Die C, ASTM D 624: 26.3 newtons per millimeter (N/mm) minimum;

g. Shore A Hardness, ASTM D 2240: Five-second interval before reading; 60 plus or minus 10;

h. Ozone Resistance, ASTM D 1149: No cracks, 7 days - 50 pphm - 37.8 degrees C, 20 percent elongation;

i. Heating Aging-Accelerated, ASTM D 573: Tensile retention, 60 percent of minimum original elongation retention; 60 percent of minimum original requirement; 7 days, 115.6 degrees C;

j. Butyl Identification, ASTM D 471, Tricresyl Phosphate Immersion: Maximum volume swell 10 percent, 70 hrs, 100 degrees C;

k. Low Temperature Flexibility, ASTM D 746: No failure at -40 degrees C;

l. Water Absorption, ASTM D 471: +1 percent maximum. 7 days, 70 degrees C;

m. Exposure to Fungi and Bacteria in Soil, ASTM E 154, Minimum 16 Weeks: Unaffected; and

n. Water Vapor Transmission, 26.7 Degrees C Permeance, ASTM E 96, Procedure B or BW: 8.58 x 10-7 g/Pa.s.m2 maximum.

2.2.2 Adhesive, Cement, and Tape for Use with Butyl Rubber

As recommended by the butyl rubber waterproofing membrane manufacturer.

2.3 THERMOPLASTIC MEMBRANE: POLYVINYL CHLORIDE (PVC)

Polyvinyl chloride (PVC) flexible sheets with non-woven fiberglass reinforcing not less than 1.5 mm minimum thickness.

2.3.1 Thermoplastic Membrane Performance Requirements

a. Overall thickness, ASTM D 751:, 1.50 mm min.;

b. Tensile strength ASTM D 638:, 11.03 MPa, min.;

c. Elongation at break, ASTM D 638:, 250 percent minimum;

d. Seam strength, ASTM D 638:, 90 percent minimum of tensile strength;

e. Retention of properties after heat aging, ASTM D 3045;

f. Tensile strength, ASTM D 638:, 95 percent of original;

g. Elongation, ASTM D 638:, 95 percent of original;

h. Tear resistance, ASTM D 1004:, 7.7 Kilogram Force;

i. Low Temperature Bend , ASTM D 2136:, -40 C;

j. Liner Dimensional Change, ASTM D 1204: 0.002 percent; and

k. Weight Change After Immersion in Water, ASTM D 570:, 2.0 percent maximum.

2.3.2 Adhesives

a. Adhesive for thermoplastic flashings as recommended by manufacturer.

b. Adhesive for Sub-Membrane Grid: 100% solids, two-part urethane, with minimum tensile strength of 1.04 MPa, in accordance with ASTM D 412 and adhesion to concrete of 12 ply in accordance with ASTM D 429 as recommended by manufacture.

2.3.3 Accessories

a. Securement Strip: 14 gauge stainless steel metal bar, 2.54 cm wide, pre-punched 2.54 cm on center for securement.

2.4 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

Cold applied composite sheet consisting of rubberized asphalt and cross laminated, high density polyethylene film. Not less than 1.5 mm minimum thickness is required.

2.4.1 Composite, Self-Adhering Sheeting Performance Requirements

a. Tensile Strength, ASTM D 412, Die C: 1.6 MPa minimum;

b. Ultimate Elongation, ASTM D 412, Die C: 200 percent minimum;

c. Water Vapor Transmission,ASTM E 96 26.7 Degrees CPermeance, Procedure B: 5.72 x 10-7 g/Pa.s.m2 maximum;

d. Pliability Degrees F, ASTM D 146: (180 Degrees Bend Over 25 mm Mandrel): No cracks at minus -32 degrees C;

e. Cycling Over Crack at Minus -26 degrees C: Membrane is applied and rolled across two primed concrete blocks with no separation between blocks. Crack opened and closed from zero to 6 mm. No effect at 100 cycles;

f. Puncture Resistance, ASTM E 154: 18 kg minimum;

g. Lap Adhesion at Minimum Application Temperature, ASTM D1876 Modified, 880 N/m (5 lbs/in.);

h. Peel Strength, ASTM D 903: Modified, 1576 N/m;

i. Resistance to Hydrostatic Head, ASTM D 5385:, 70 m, of water

j. Water Absorption, ASTM D 570; 0.1% maximum.

2.4.2 Primer

Asphalt composition, ASTM D 41, or synthetic polymer in solvent as recommended by the membrane manufacturer.

2.4.3 Mastic

Polymer modified asphalt in suitable solvent of trowel-grade consistency and as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify that surfaces to be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to be treated are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to be covered before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.3 APPLICATION

Follow manufacturer's printed installation instructions. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor. Provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces as indicated and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

a. Non-Self-Adhering Membrane: Unroll membrane and allow to remain flat for at least one-half hour before application. Apply an asphalt concrete primer prior to application of asphaltic adhesive. Where solvent adhesive is applied, allow major portion of solvent to evaporate so that bonding adhesive does not stick to a dry finger touching it. Apply elastomeric waterproofing membrane in a full bed of adhesive at a uniform coverage rate in accordance with the recommendations in the membrane manufacturer's printed instructions. Where membrane on horizontal surfaces are to receive concrete fill, apply adhesive in 100 mm wide strips at 600 mm on center. Pull membrane tight without stretching. As soon as adhesive is fully set and dry, recheck lap splices. Where openings or fishmouths appear, reseal and reroll lap splices.

b. Self-Adhering Membrane: Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.

c. Protection: Protect membrane over horizontal surfaces from abnormal traffic during installation. Use only equipment with rubber tires. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on membrane.

3.3.1 Butyl Rubber

Lap sheets at sides and ends a minimum of 150 mm over the preceding sheet. Apply lap splicing cement over entire 150 mm splice area prior to application of sealant. Sealant shall be continious along the entire length of the splice. Maintain a continuous bead of sealant at all membrane splices or as required by the manufacturer. When membrane will be below water table, provide a tongue and groove cemented splice a minimum of 150 mm with factory made heat vulcanized seam not less than 50 mm or as required by the manufacturer.

3.3.2 Thermoplastic Membrane (PVC)

Deck shall be clean, smooth and dry without surface irregularities. Consult with membrane manufacturer prior to grid application. Install 30.48 cm wide sub-membrane containment grid as required by manufacturer. Provide and install the containment grid at intervals across the width and length of the substrate, at the base of all transitions, walls, curbs, penetrations, and at the perimeter of each deck/substrate section. Fully adhere strips to the deck in a full bedding of two-part urethane adhesive medium. Adjacent sheets shall be welded in accordance with manufacturer's instructions. All side and end lap joints shall be hot-air welded. Lap area shall be a minimum of 7.62 cm wide when machine welding, and a minimum of 10.16 cm wide when hand welding but not less than recommended by the manufacturer. Overlaps shall be with the flow of water.

3.4 COMPOSITE, SELF-ADHERING MEMBRANE

Lap sheets at edges and ends a minimum of 65 mm over the preceding sheet. All side laps shall be minimum 65 mm and end laps shall be 127 mm. Laps shall be self adhesive, mastic as per manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with two layers of reinforcement by first applying a 300 mm width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 150 mm from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a trowelled bead of mastic. Apply mastic around edges of membrane, and drains and projections. Apply mastic at end of each work day.

3.5 FLASHING

Flash penetrations through membrane. Ensure that where reinforcing bars penetrate a waterproofing membrane, each of those penetrations be sealed with the appropriate sealant or mastic flashing component. Embed elastomeric membrane in a heavy coat of adhesive, except for self-adhering membrane. Continuous metal reglets shall be installed, horizontally on footing and vertically on intersecting and connecting walls, and as specified in Section 07 60 00 FLASHING AND SHEET METAL. Metal reglets shall receive exposed edges of membrane waterproofing. Secure membrane into reglets by lead wedges and fill with cement as recommended by manufacturer of waterproofing materials. Counterflash upper edge of membrane waterproofing and protective covering as specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.6 FIELD QUALITY CONTROL

Notify the Contracting Officer one day prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 75 mm of ponded water for 24 hours. Do not add water after start of 24 hour period. Carefully measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of Contracting Officer.

-- End of Section --

SECTION 07 21 13

BOARD INSULATION
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 1289	(2006) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 165	(2005) Standard Test Method for Measuring Compressive Properties of Thermal Insulations
ASTM C 203	(2005a) Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C 272	(2001) Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 552	(2003) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(2006) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2005) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 1621	(2004a) Compressive Properties of Rigid Cellular Plastics
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes

ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 828	(1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 154	(1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	(2006; Errata 2006) Installation of Oil Burning Equipment
NFPA 54	(2006) National Fuel Gas Code
NFPA 70	(2005; TIA 2005) National Electrical Code

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	(2006) Puncture Test of Container Board

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

29 CFR 1910.134	Respiratory Protection

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

Board insulation; G

Vapor retarder

Pressure sensitive tape

Protection board or coating

Accessories

SD-08 Manufacturer's Instructions

Board Insulation

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 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board 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. Water Vapor Permeance: Not more than 6.3 x 10-8 g/Pa.s.m2 or less when measured according to ASTM E 96, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

c. 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 more than one percent of asbestos.

2.2 VAPOR RETARDER AND DAMPPROOFING

2.2.1 Vapor Retarder in Frame Walls and Roofs

a. 0.15 mm thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of 5.72 x 10-8g/Pa.s.m2 or less when tested in accordance with ASTM E 96.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of 5.72 x 10-8 g/Pa.s.m2 or less when tested in accordance with ASTM D 3833/D 3833M.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 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 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Unless using insulation board that passes ASTM E 136 in addition to the requirements in Part 2, install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed electrical fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 75 mm from outside face of fixtures and devices or as required by NFPA 70and, if insulation is to be placed above fixture or device, 600 mm above fixture.

b. Masonry chimneys or masonry enclosing a flue: 50 mm from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: minimum clearances as required by NFPA 211.

f. Gas Fired Appliances: Clearances as required in NFPA 54.

g. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking is not required if chimneys or flues are certified by the Manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 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.

3.3.2 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.3 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.4 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.

3.4 INSTALLATION ON WALLS

3.4.1 Installation using Furring Strips

Install insulation between members as recommended by insulation manufacturer.

3.4.2 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. Install board in wall cavities so that it leaves at least a nominal 25 mm free air space outside of the insulation to allow for cavity drainage.

3.4.3 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.4.4 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's instructions. Install protection over all exterior exposed insulation board and down to 300 mm below grade.

3.5 VAPOR RETARDER

Apply a continuous vapor retarder as indicated. Overlap all joints at least 150 mm and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

3.6 ACCESS PANELS AND DOORS

Affix insulation to all access panels greater than 0.1 square meter and all access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 828	(1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	(2006; Errata 2006) Installation of Oil Burning Equipment
NFPA 54	(2006) National Fuel Gas Code
NFPA 70	(2005; TIA 2005) National Electrical Code

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM (2006) Puncture Test of Container Board

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

29 CFR 1910.134 Respiratory Protection

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

Blanket insulation; G

Sill sealer insulation; G

Vapor retarder; G

Pressure sensitive tape; G

Accessories; G

SD-08 Manufacturer's Instructions

Insulation; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to 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 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational

Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings and II, blankets with non-reflecting coverings and III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less , except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 SILL SEALER INSULATION

ASTM C 665, Type I.

2.3 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

2.4 VAPOR RETARDER

a. 0.15 mm (6 mil) thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of 5.72 x 10-8g/Pa.s.m2 (1 perm) or less when tested in accordance with ASTM E 96.

2.5 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of 5.72 x 10-8 g/Pa.s.m2 or less when tested in accordance with ASTM D 3833/D 3833M.

2.6 ACCESSORIES

2.6.1 Adhesive

As recommended by the insulation manufacturer.

2.6.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.6.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that 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 moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking around attic trap doors. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 75 mm from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 600 mm above fixture.

b. Masonry chimneys or masonry enclosing a flue: 50 mm from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

f. Gas Fired Appliances: Clearances as required in NFPA 54.

g. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not

required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.1.5 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 150 mm intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

3.3.1.6 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

3.3.1.7 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.8 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents. Attach insulation to attic door by adhesive or staples.

3.3.1.9 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

3.3.1.10 Special Requirements for Floors

Hold insulation in place with corrosion resistant wire mesh, wire fasteners, or wire lacing.

3.3.1.11 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 150 mm and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07 41 13

NON-STRUCTURAL METAL ROOFING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(2006) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM D 1308	(2002e1) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2224	(1978; R 1983) Standard Test Method for Mean Molecular Weight of Mineral Insulating Oils by the Cryoscopic Method

ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4587	(2001) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D 4637	(2004) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss
ASTM D 5894	(1996) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2001) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(2002e1) Evaluating Degree of Blistering of Paints
ASTM D 968	(2005) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2001) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM G 154	(2000ae1) Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2000) Metal Roofing Systems Design Manual

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	(2001; R 2003, 5th Ed) Roofing and Waterproofing Manual

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies

1.2 DESCRIPTION OF METAL ROOF SYSTEM

Galvanized metal panel roof system with exposed fastener attachment through to deck substrate. Roof panel profile shall be corrugated except where indicated otherwise.

1.2.1 Design Requirements

1.2.2 Wind Uplift Resistance

Metal roof panel assembly shall resist wind loads as indicated.

1.2.2.1 Performance Requirements

The installed roof assembly shall be watertight, conform to the roof slope, and resist the uplift pressures calculated or indicated. The Contractor shall furnish a commercially available roofing system which satisfies all 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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Roofing; G

Drawings consisting of catalog cuts, panel configuration, system assembly, attachment details, roof curb details, flashing details, erection drawings, and other data as necessary to clearly describe layouts, construction details, fasteners, and erection. Drawings shall be approved by the metal roofing manufacturer prior to submission.

SD-03 Product Data

Roof panels; G

Accessories; G

Fasteners; G

Underlayments; G

Gaskets and Insulating Compounds

Roof curbs

SD-04 Samples

Roof Panels; G

One piece of each type and finish to be used, 9 inches long, full width.

Factory-applied Color Finish Charts; G

Provide standard color charts for roof panel and accessory color selection.

Accessories; G

One sample of each type of roof curb, flashing, trim, fascia, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Fasteners; G

Two samples of each type to be used with statement regarding intended use.

Gaskets and Insulating Compounds

Two samples of each type to be used and descriptive data.

Sealant; G

SD-05 Design Data

Wind Uplift Resistance; G

Engineering calculations validating the wind resistance of non-tested roof system. Calculations shall be prepared, signed, and sealed by a registered structural engineer.

SD-06 Test Reports

Roof Assembly; G,

Factory Color Finish Performance Requirements

SD-07 Certificates

Roof Panels; G,

Certificates from the roof panel manufacturer attesting that the panels and accessories conform to the specified requirements and are suitable for the installation environment at the indicated design slope.

Coil stock compatibility; G,

Provide certification of coil compatibility with roll forming machinery to be used in the field.

Self-Adhering Modified Bitumen Underlayment

Certify underlayment compatibility with service conditions of the roof installation.

Qualification of Manufacturer; G,

Certify that the manufacturer of the roof membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator; G,

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

SD-08 Manufacturer's Instructions

INSULATION

INSTALLATION

Roof panel installation manual; G

Submit manufacturer's printed installation manual and instructions.

SD-09 Manufacturer's Field Reports
Copy of manufacturer's field inspection reports, submitted within 48 hours of each site visit.

SD-11 Closeout Submittals

Warranties

Information card

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Metal roof panel manufacturer shall have been in the business of manufacturing metal roof panels for a period of not less than 5 years.

1.4.2 Qualification of Applicator

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

1.4.3 Preroofing Conference

After approval of submittals and before performing roofing 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 representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Preroofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of metal roof system, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the metal roofing 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

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

1.5.1 Delivery

Deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the site. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Storage

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

1.5.3 Handling

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

1.6 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Revision or amendment to manufacturer's standard warranty shall be provided as required to comply with the specified requirements.

1.6.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 10-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, components, trim, and accessories necessary for a watertight roof system construction. The warranty shall run directly to the Government and commence at time of Government's acceptance of the roof work. The warranty shall state that:

a. If within the warranty period the metal 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, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship shall be the responsibility of the metal roof panel manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the metal roof panel manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others shall not void the warranty.

1.6.2 Manufacturer's Finish Warranty

Provide a manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2224.

1.6.3 Metal Roof System Installer Warranty

Provide the "Contractors Five (5) Year No Penal Sum Warranty for Non-Structural Metal Roof System" attached at the end of this section.

1.6.4 Continuance of Warranty

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

1.7 CONFORMANCE AND COMPATIBILITY

The entire metal roofing and flashing system shall be in accordance with specified and indicated requirements, including wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the MBMA RSDM, NRCA 0405, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 ROOF PANELS

Roof panels shall be steel with a factory-applied color finish. Panel attachment shall be with exposed fasteners. Panel profile shall be corrugated unless indicated otherwise. Roof panels shall provide nominal 300 mm (12 inches) of coverage in place. Minimum height of corrugations at overlap of adjacent roof sheets shall be the panel manufacturer's standard for the indicated roof slope. Individual panels shall be of continuous length sufficient to cover the entire length of any unbroken roof slope with no joints or seams, except where indicated or approved otherwise by the Contracting Officer. Panels shall be formed without warping, waviness, or ripples that are not a part of the panel profile and shall be free of damage to the finish coating system. Provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut.

2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M, Structural Grade 40 and minimum G90 galvanized smooth metallic coating; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 50 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Prepainted steel sheet shall also comply with ASTM A 755/A 755M. Roof panel material shall be minimum 0.76 mm (22 gage) thick prior to coating application, and as required to meet wind uplift requirements. Panels shall be within 95 percent of the nominal thickness. Prior to shipment, mill finish panels shall be treated with a passivating chemical and oiled to inhibit the formation of oxide corrosion products. Panels that have become wet during shipment and have started to oxidize shall be rejected.

2.1.2 Texture

Stucco embossed.

2.2 ROOF PANEL FACTORY COLOR FINISH

Provide factory-applied, thermally cured coating system on roof panel surfaces. Provide exterior coat of primer and color finish coat on the exposed side. Prime coat shall be not less than 0.005 mm (0.2 mil). Color finish coat shall be not less than 0.02 mm (0.8 mil). Total color coating system thickness shall be not less than 0.030 mm and with any additional primer and finish coat thickness required to meet the color finish performance requirements specified. Provide manufacturer's standard factory-applied clear coat system over color finish coat. Underside coating shall

consist of roof panel manufacturer recommended protective backer coat suitable for the application conditions, not less than 0.008 mm (0.3 mil) thick unless approved otherwise by the Contracting Officer. Finish coat color shall be as selected by Contracting Officer from manufacturer standard color charts. The exterior color finish shall meet the performance requirements specified.

2.2.1 Factory Color Finish Performance Requirements

2.2.1.1 Cyclic Salt Fog/UV Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2014 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; no rusting, as determined by ASTM D 610; and a rating of 7, less than 1.5 mm (1/16 inch) creepage from scribe as determined by ASTM D 1654.

2.2.1.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm (1/8 inch) diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

2.2.1.3 Accelerated Weathering, Chalking Resistance and Color Change

Coating sample shall withstand weathering test of 5000 hours , in accordance with ASTM D 4587 and ASTM G 154, Type D, without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating with an adhesion rating of less than 4B when tested in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2224.

2.2.1.4 Humidity Test

When subjected to a humidity cabinet test in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.2.1.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 13 mm (0.50 inch) diameter hemispherical head indenter, equal to 1.5 times the metal thickness in mils, expressed in inch-pounds, with no cracking.

2.2.1.6 Abrasion Resistance Test

When subjected to the falling sand test in accordance with ASTM D 968, Method A, the coating system shall withstand a minimum of 80 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.2.1.7 Specular Gloss

Finished roof surfaces for shall have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

2.2.1.8 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.3 ACCESSORIES

Accessories shall be compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded foam rib, ridge and other closure strips shall be closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and shall not absorb or retain water.

2.3.1 Pre-manufactured Accessories

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Curbs shall be constructed to match roof slope and shall meet requirements in Section 13 34 19.

2.4 FASTENERS

Fasteners for roof panels shall be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel, compatible with the sheet panel or flashing material and of type and size recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed fasteners shall have integral metal washer head and compressible sealing EPDM washer. Sealing washer shall be approximately 2.4 mm (3/32 inch) thick. Exposed portion of fasteners shall match color of attached material.

2.4.1 Screws

Not smaller than 6 mm (No. 14) diameter self-tapping type and not less than 4 mm (No. 12) diameter self-drilling type.

2.4.2 Rivets

Closed-end type where watertight connections are required.

2.5 UNDERLAYMENTS

2.5.1 Self-Adhering Modified Bitumen Underlayment

Self-adhering modified bitumen membrane underlayment material in compliance with ASTM D 1970, and suitable for use as underlayment for metal roofing. Membrane resistant to cyclical elevated temperatures for extended period of time shall be used in high heat service conditions. Membrane shall have

integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.

2.5.2 Slip Sheet

Slip Sheet shall be 0.24 kg per square meter (5 pounds per 100 sf) rosin sized unsaturated building paper.

2.6 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt, as recommended by the roof panel manufacturer. Silicone based sealants are prohibited, unless approved otherwise by the roof panel manufacturer and the Contracting Officer. Exposed sealant shall be high quality polyurethane and shall be colored to match adjacent components and shall cure to a rubberlike consistency. Concealed sealant shall be non-hardening type. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.7 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive metal roof panel and flashing installation. Ensure surfaces are suitable, dry and fee of defects and projections which might affect the installation.

3.2 INSTALLATION

Installation shall meet specified requirements and be in accordance with the manufacturer's installation instructions and approved shop drawings. Correct defects or errors in materials and installation. Do not install damaged materials. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged materials shall be removed from the site.

3.2.1 Underlayment

Install underlayment parallel to roof slope and in a watershedding fashion. Install self-adhering underlayment in accordance with manufacturer's instructions. Self-adhering underlayment may be installed parallel to roof slope with the approval of the Contracting Officer. Provide a minimum 1 meter (36 inch) wide sheet of self-adhering modified bitumen membrane underlayment at all penetrations, eaves, rakes, hips, ridges, valleys, slope transitions, and side wall and head wall transitions. Ice dam protection shall extend minimum 36 inches inside of building wall line and as otherwise necessary to provide effective protection from water intrusion due to ice daming. Turn underlayment up minimum 4 inches at vertical transitions,

except as otherwise indicated. Underlayment shall be concealed by finished flashing and cladding construction. Ensure underlayment is attached in a manner to hold in place until metal roof panels are installed. The underlayment shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

3.2.1.1 Slip Sheet

Apply specified slip sheet at time of roof panel installation when felt or other underlayment is used that may be in direct contact with and adhere to or adversely impact the underside of roof panels, and as otherwise recommended by the roof panel manufacturer.

3.2.2 Roofing

Apply roofing panels with longitudinal configurations in the direction of the roof slope. Provide roofing panels in unbroken lengths from peak to low point with no transverse joints except at junction of ventilators, curbs, skylights, chimneys, and similar openings, unless otherwise indicated or approved by the Contracting Officer. Where panel end laps are required, form and install to shed water and seal in a watertight manner as recommended by the panel manufacturer's installation instructions. Attach roof panels in the manner, type and frequency required by the roof panel manufacturer and to resist required wind uplift pressures. Close panel ribs or side laps as required by the manufacturer to meet specified requirements. Lay side laps away from prevailing wind. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's instructions. Flash seal roof at ridge, eaves, rakes, and at projections through roof. All sheet metal laps, including but not limited to panel side laps end laps, flashing laps and junctures at accessories and penetrations flashings, shall be sealed watertight within the lap area. Closure strips, flashing, and sealing material shall be provided as indicated and where otherwise necessary to provide complete weathertight construction.

3.2.2.1 Field Forming of Roof Panels

Roll forming equipment shall be maintained in proper working order and operated by a factory trained technician. Field formed panels shall meet all specified requirements. Where UL 580 classified materials are required, rollformer equipment certification shall be provided. In cold weather conditions, warming of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.2.3 Accessories

Provide all roof curb, flashings, related closures, and accessories necessary for a complete, watertight installation. Minimize exposed fastening of flashings. On sloped planes, form flashing lap joints to shed water and provide sealant within the lap area. Laps joints shall have minimum 100 mm (4 inch) overlap except where greater overlap is indicated, or otherwise required by the roof panel manufacturer. For butt joints of flashings, provide joint splice and cover plates supplemented by waterproof sealants and sealant tapes to form a watertight joint condition. Ensure firm underlying support for joints greater than 200 mm (8 inches) wide and where otherwise indicated or required by the roof panel manufacturer. Installation shall allow for expansion and contraction of flashing without impacting watertight integrity. Set roof curbs so top surface of roof curb is level.

3.2.4 Exposed Fastener Installation

Where exposed fastening is required, provide fastener spacings in accordance with manufacturer's recommendations, in straight lines and to present a uniform appearance. Drive fasteners normal to surface and to uniform depth to seat washers with gaskets without tearing or cracking gasketing material. Exercise extreme care when drilling pilot hole for fastenings to keep drills perpendicular and centered. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used when applying fasteners shall not exceed that recommended by manufacturer. Remove metal shavings and filings from roofs upon completion to prevent rusting and discoloration of panels.

3.3 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.4 CLEAN UP AND FINISH TOUCH-UP

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

3.5 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions shall be as directed by the Contracting Officer.

3.6 FIELD QUALITY CONTROL

3.6.1 Construction Monitoring

During progress of the roof work, Contractor shall make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

Materials comply with the specified requirements.

All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.

a. Substrates are in acceptable condition, in compliance with specification, prior to application of underlayment, roof panel, and flashing materials.

Nailers and blocking are provided where and as needed.

Underlayment is installed as required and of type required.

Slip sheet, if required, is installed as roof panels are installed.

Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.

Side laps are formed, sealed, fastened or seam locked as required.

The proper number, type, and spacing of attachment clips and fasteners are installed.

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.

3.6.2 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of three times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections shall occur during the first 20 squares of roof panel installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections shall not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.7 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 (0.032) inch thick aluminum card for exterior display. Card shall be 215 mm by 275 mm (8 1/2 by 11 inches) minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment(s), date of completion; installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. The card shall be a minimum size of 215 mm by 275 mm (8 1/2 by 11 inches). Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.

6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
01/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1	(20035) Standard for Retrofit Roof Drains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 308/A 308M	(2003) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 101	(2002) Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 32	(2004) Standard Specification for Solder Metal

ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 69	(2001a; R 2005) Standard Specification for Rolled Zinc
ASTM D 1784	(2006a) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(2000; R 2006) Asphalt Roof Cement, Asbestos-Free

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

SMACNA Arch. Manual	(2003, 6th Ed) Architectural Sheet Metal Manual

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 repsonsible 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

Covering on flat, sloped, or curved surfaces

Gutters

Downspouts

Expansion joints

Gravel stops and fascias

Splash pans

Flashing for roof drains

Base flashing

Counterflashing

Flashing at roof penetrations

Reglets

Scuppers

Copings

Drip edge

Conductor heads

Open valley flashing

Eave flashing

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: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.1.3.1 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 approved by Contracting Officer from manufacturers standard list submitted by the contractor.

2.1.4 Zinc Sheet and Strip

ASTM B 69, Type I, a minimum of 0.61 mm thick.

2.1.5 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.6 Terne-Coated Steel

Minimum of 350 by 500 mm with minimum of 18 kilogram coating per double base box. ASTM A 308/A 308M.

2.1.7 Aluminum Alloy Sheet and Plate

ASTM B 209M, color as approved by Contracting Officer from manufacturers standard list submitted by the contractor.

2.1.7.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on both sides unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Fascias

c. Flashing

2.1.7.2 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 from manufacturers standard list submitted by the contractor.

2.1.8 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221M.

2.1.9 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.10 Polyvinyl Chloride Reglet

ASTM D 1784, Type II, Grade 1, Class 14333-D, 1.9 mm minimum thickness.

2.1.11 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.12 Roofing Felt
ASTM D 226 Type I.

2.1.13 Asphalt Primer

ASTM D 41.

2.1.14 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 Arch. Manual, 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.

3.1.5.4 Standing Seams

Not less than 25 mm high, double locked without solder.

3.1.5.5 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. 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 Base Flashing

Extend up vertical surfaces of the flashing not less than 200 mm and not less than 100 mm under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 150 mm. Overlap the flashing strips with the previously laid flashing not less than 75 mm. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inch on center with hex headed, galvanized shielded screws a minimum of 2-inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of chimneys, curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 115 mm at the lower side of chimneys, and similar vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.11 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 8 inch by 8 inch 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 chimneys and 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.

3.1.12 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.

3.1.12.1 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.

3.1.12.2 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 and fill with sealant.

3.1.13 Polyvinyl Chloride Reglets Temporary Construction Installation

Rigid polyvinyl chloride reglets ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness may be provided in lieu of metal reglets for temporary construction.

3.1.14 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.

3.1.15 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 20 by 5 mm of material compatible with gutter. Fabricate gutters in sections not less than 2400 mm. Lap the sections a minimum of 25 mm in the direction of flow or provide with concealed splice plate 150 mm minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that

snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 750 mm on center by continuous cleats and or by cleats spaced not less than 36 inch apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.1.16 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 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.

3.1.16.1 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. Set precast splash blocks of 4000 psi concrete with 6 percent air content on solid support true to line and grade for drainage. Splash blocks shall be precast at manufacturer's plant or 4000 psi concrete with 6 percent air content, have smooth surfaces true to line and face, and be free from defects and sharp rises. Provide splash pans as specified.

3.1.17 Eave Flashing

One piece in width, applied in 2400 to 3000 mm lengths with expansion joints spaced as specified in paragraph entitled "Expansion and Contraction." Provide a 20 mm continuous fold in the upper edge of the sheet to engage cleats spaced not more than 250 mm on center. Locate the upper edge of flashing not less than 450 mm from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with 25 mm flat locked joints with cleats that are 250 mm on center.

3.1.18 Sheet Metal Covering on Flat or Sloped Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, and small decks with metal sheets of the material used for flashing; maximum size of sheets, 375 by 455 mm. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.19 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.

3.1.20 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. 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.

3.1.21 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.1.22 Copings

Provide coping using copper sheets 2400 or 3000 mm long joined by a 20 mm locked and soldered seam. Terminate outer edges in edge strips. Install with sealed joints as indicated.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the

contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Aluminum, mm	Stainless Steel, mm	Terne-Coated Stainless Steel, mm	Zinc-Coated Stainless Steel, mm
Building Expansion Joints				
Cover.....	0.81	0.38	0.38	0.6
Waterstop-bellows or flanged, U-type.....	-	0.38	0.38	-
Covering on minor flat, pitched or curved surfaces.....	1.02	0.46	0.46	-
Downspouts and leaders.....	0.81	0.38	0.38	0.6
Downspout clips and anchors.....	-	1.02 clip	-	- -
	-	3.175 anchor	-	- -
Downspout straps, 50 mm.....	1.52	1.27	-	-
Strainers, wire diameter or gage....	3.66 diameter	2.77 diameter		-
Flashings:				
Base.....	1.02	0.46	0.46	0.6
Cap (Counter-flashing)	0.81	0.38	0.38	0.5
Eave.....	-	0.38	0.38	0.6
Spandrel beam.....	-	0.25	0.25	-
Bond barrier.....	-	0.38	0.38	-
Stepped.....	0.81	0.38	0.38	-
Roof drain.....				
Pipe vent sleeve(d)				

Gravel stops and fascias:				
Extrusions.....	1.91	-	-	-
Sheets, corrugated.....	0.81	0.38	0.38	-
Sheets, smooth.....	1.27	0.46	0.46	0.6
Edge strip.....	1.27	0.635	-	-
Gutters:				
Gutter section.....	0.81	0.38	0.38	0.6
Continuous cleat.....	0.81	0.38	0.38	0.6
Hangers, dimensions.....	25 mm x 2 mm (c)	25 mm x 1 mm	-	-
Joint Cover plates... See Table II)	0.81	0.38	0.38	0.6
Reglets (c).....	-	0.25	0.25	-
Splash pans.....	1.02	0.46	0.46	-

(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.

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E 119	(2007) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	(1997; R 2000) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2001) Fire-Resistive Joint Systems
ASTM E 814	(2002) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM AS 4991	(2001) Approval of Firestop Contractors
FM P7825a	(2005) Approval Guide Fire Protection

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003) Fire Tests of Through-Penetration Firestops
UL 2079	(2004) Tests for Fire Resistance of Building Joint Systems
UL 723	(2003; Rev thru May 2005) Standard for Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2007) Fire Resistance Directory Set

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

Firestopping Materials.

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 judgement, 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" and "T" ratings, and type of application.

SD-07 Certificates

Firestopping Materials.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

Inspection.

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 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop 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. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. 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 top of the fire-rated walls and the roof or floor deck above.

1.4 DELIVERY AND STORAGE

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, 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 per 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 qualification 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.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied 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.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free, noncombustible products FM P7825a 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 to humans at all stages of application or during fire conditions.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM P7825a approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetraded openings are to be protected, except that "F" rating may be 3 hours in through-penetrations of 4 hour fire rated wall or floor. Firestop systems shall also have "T" rating where required.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" 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, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = 1 hour, T Rating = 1 hour.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks 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 per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

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. Surfaces shall be prepared as recommended by the manufacturer.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces 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. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided 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. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.3 INSPECTION

For all projects, 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. The Contractor shall 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.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
01/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 1311	(2002) Standard Specification for Solvent Release Agents
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	(2006) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(2005) Latex Sealants
ASTM C 919	(2002) Use of Sealants in Acoustical Applications
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 217	(2002) Cone Penetration of Lubricating Grease
ASTM D 2452	(2003) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D 2453	(2003) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E 84	(2007) 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. Lable 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 fiveyears.

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 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.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected
e.	Joints between ablution trough and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	As selected
f.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occuring where substrates change.	As selected
g.	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	Match adjacent surface color

	metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b.	Joints between new and existing exterior masonry walls.	Match adjacent surface color
c.	Masonry joints where shelf angles occur.	Match adjacent surface color
d.	Expansion and control joints.	Match adjacent surface color
e.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
f.	Voids where items pass through exterior walls.	Match adjacent surface color
g.	Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
h.	Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color
i.	Joints between ends of 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 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C, the sealant must be non-bleeding and no loss of adhesion.

2.2 PRIMERS

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

2.3 BOND BREAKERS

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

2.4 BACKSTOPS

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

2.4.1 Rubber

Conform to ASTM D 1056, Type 2, closed cell, Class A, Grade round, cross section for cellular rubber sponge backing.

2.4.2 Synthetic Rubber

Conform to ASTM C 509, Option I , Type I preformed rods for Synthetic rubber backing.

2.4.3 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.4.4 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, color as selected by contracting officer from manufacturers standard listing submitted by contractor, conforming to ASTM C 1311.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453, Type I for Oil- and resin-based caulking.

2.6 CLEANING SOLVENTS

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

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing calk 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 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. Laitance, remove 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

07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 879/A 879M	(2006) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A 924/A 924M	(2006) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 578	(2006) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2005) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM D 2863	(2006a) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A115	(2006) (Complete Set - Spec dates Vary) Specifications for Door and Frame Preparation for Hardware (Incl A115.1 (1990), A115.2 (1987), A115.4 (1994), A115.5 (1992), A115.6 (1993), A115.12 (1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 (1994)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA HMM	(1999; R 2000) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	(2006) Installation of Smoke Door Assemblies
NFPA 252	(2003) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2000) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	(2001) Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	(2001) Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.3	(1999) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
SDI/DOOR A250.4	(2001) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
SDI/DOOR A250.6	(2003) Hardware on Steel Doors (Reinforcement - Application)
SDI/DOOR A250.8	(2003) Recommended Specification for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997; Rev thru Oct 2001) Fire Tests of Door Assemblies

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel internal reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples

Factory-applied enamel finish; G

Where colors are not indicated, submit manufacturer's standard colors and patterns for selection.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap frames in bundles. 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.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware. 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.

2.2 INSULATED STEEL DOOR SYSTEMS

Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 0.7 mm thick, 1.5 mm thick, and 1.5 mm respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Doors shall have been tested in accordance with SDI/DOOR A250.4 and shall have met the requirements for Level C. Prepare doors to receive specified hardware.Doors shall be 44.5 mm thick. Provide insulated steel doors and frames at exterior doors to all buildings.

2.3 ACCESSORIES

2.3.1 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 2, 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 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.4.3 Stops and Beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.4 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.

2.4.4.1 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;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.4.4.2 Floor Anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.5 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.5.1 Door and Frame 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 10B. 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.

2.5.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.6 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

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 BHMA A115. 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 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 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 879/A 879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.8.2 Factory-Applied Enamel Finish

Coatings shall meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of medium-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements shall be in accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as selected by Contracting Officer from manufacturers standard listing submitted by contractor and shall match approved color sample(s).

2.9 GLAZING

Vision panel requirements shall be as shown and as specified in Section 08 81 00.

2.10 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 3 mm larger than the actual masonry thickness. Design other frames in exposed masonry walls or

partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.10.1 Grouted Frames

Frames to be installed in exterior walls are 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. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

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 22 00

PLASTIC DOORS AND FRAMES
10/07

PART 1 GENERAL

1.1 SUBMITTALS

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

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories; G

Show elevations, construction details, metal gages, hardware provisions, 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; G

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, internal reinforcement, and door edge construction.

SD-04 Samples

Factory-applied finish; G

Submit manufacturer's standard colors and patters for selection by the Contracting Officer.

1.2 DELIVERY, STORAGE AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Store doors and frames in manufacturer's unopened

packaging on platforms under cover in dry, ventilated, and accessible locations until ready for installation. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

1.3 PROJECT CONDITIONS

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.4 WARRANTY

At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage. Duration: One (1) year.

PART 2 PRODUCTS

2.1 DOOR PANEL

2.1.1 Material

Rigid Polyvinyl Chloride (PVC)

2.1.2 Slab Thickness

44.5 mm

2.1.3 Internal Assembly

Open, insulatable vertical chambers running the height of the door. Reinforced at third points (2 sides and middle) with 16 gauge galvanized steel.

2.1.4 Wall Thickness

Internal Walls: 0.8 mm; External Walls: 1.8 mm

2.1.5 Door Sweeps

Upper: Double track felt; Lower: 48 mm adjustable track with 25 mm rubber sweep on each panel.

2.2 DOOR JAMBS

2.2.1 Jambs

Material: Rigid Celular Polyvinyl Chloride (PVC)

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly prepared. If substrate preparation is the reponsibility of another installer, notify Contracting Officer of unsatisfactory preparation before proceeding.

3.2 PREPARATION

Clean surfaces thoughly prior to installation. Prepare surfaces using the method recommended by the manufacturer for acheiving the best result for the substrate under the project conditions.

3.3 INSTALLATION

Install in accordance with the manufacturer's instructions. Install door plumb, level and square without warp, bow or rack. Install shims as each fastening location. Do not paint or otherwise finish doors.

3.4 CLEANING AND MAINTENANCE

Clean with a mild detergent or soap scum remover. Where detergents do not work, low pressure washers with mild soap and a soft cloth may be used. Multi-purpose cleaners may be used, provided they are PVC compatible. Spot test material in an inconspicuous location prior to cleaning. Do not use abrasive cleaners. Repair minor damages to finish in accordance with the manufacturer's instructions. Where damage cannot be repaired, remove and replace damaged Work in accordance with manufacturer's instructions.

3.5 PROTECTION

Protect installed products until completion of project. Touch-up, repair or replace damaged products before Substantial Completion.

-- End of Section --

SECTION 08 33 13

METAL ROLLING COUNTER DOORS
05/09

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 240/A 240M	(2009a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2006; Errata 2008; Errata 2008) Standard for Fire Doors and Other Opening Protectives

1.2 SUSTEM DESCRIPTION

Furnish rolling counter doors of the type, size, and design indicated on the drawings. Provide the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Provide each door with a permanent label showing the manufacturer's name and address and the model number of the door.

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

Detail drawings as specified.

SD-03 Product Data

Rolling Counter Doors

Manufacturer's descriptive data and catalog cuts.

Installation
Cleaning

Manufacturer's preprinted installation and cleaning instructions.

SD-10 Operation and Maintenance Data

Rolling Counter Door (Non-Rated)
Fire-Rated Rolling Counter Door

Six complete copies of Data Package 2 for Rolling Counter Doors (Non-Rated) and Fire-Rated Rolling Counter Doors in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

1.4 QUALITY ASSURANCE

Submit Detail Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. Include a schedule showing the location of each counter door with the drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver rolling counter doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store rolling counter doors in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Handle doors carefully to prevent damage. Replace damaged items that cannot be restored to like-new condition.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

Fabricate the curtain of Type 304 stainless steel slats conforming to ASTM A 240/A 240M, Type 304 or Type 430. Provide thickness of slat material as required by width of opening or as required by specified fire-rating. Use slats approximately 32 to 38 mm wide with a depth of crown of 13 mm. Fit alternate slats with end locks to maintain curtain alignment. Provide bottom of curtain with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Furnish guides of minimum thickness stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430.

2.1.3 Counterbalance Shaft Assembly

Furnish the curtain coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 2.5 mm per meter. Provide a barrel containing oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Calculate the springs to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Furnish brackets of a minimum 2.657 mm thickness steel if flat plate, or 1.519 mm thickness if there are a minimum of 3 returns of 19 mm width.

2.1.5 Hood

Provide a hood of [1.02 mm minimum thickness aluminum sheet conforming to ASTM B 209M, Alloy 5005.] [0.607 mm stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430.] [0.607 mm galvanized steel conforming to ASTM A 653/A 653M, Coating Designation [G60] [G90].]

2.1.6 Locks

Lock the curtain at each side of the bottom bar by an integral slide bolt suitable for padlocks by others. Locate lock on the Kitchen side of the counter door.

2.2 FIRE-RATED ROLLING COUNTER DOOR

Furnish fire-rated rolling counter doors, Class B (1-1/2 hr.) rated and conforming to the requirements specified and to NFPA 80 for the class indicated. Provide labels of a recognized testing agency for the doors, indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors will take precedence over details indicated or specified herein. Furnish door curtains, guides and hood of stainless steel. Provide fire-rated rolling counter doors complete with hardware, accessories, and automatic closing device. Provide rolling counter doors, in exit corridor walls, with perimeter smoke and draft control gasketing.

2.3 AUTOMATIC CLOSING DEVICE

Equip fire-rated counter doors with an automatic closing device which operates upon the fusing of a 74 degrees C fusible link

2.4 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Furnish stainless steel with a No. 4 finish. Give all other steel parts a shop coat of primer paint in color that is standard with the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Install doors in accordance with approved detail drawings and manufacturer's instructions. Accurately locate anchors and inserts for guides, brackets, hardware, and other accessories. Upon completion, doors shall be free from warp, twist, or distortion. Lubricate, properly adjust, and demonstrate doors to operate freely. Conform fire-door installation with NFPA 80 for the class indicated and the manufacturer's instructions.

3.2 OPERATION

3.2.1 Manual Operation

Provide curtain operated by means of manual push-up with lift handles or continuous full width lift bar.

3.3 TESTS

Drop-test the fire doors in accordance with NFPA 80 to show proper operation and full automatic closure and reset in accordance with the manufacturer's instructions. Provide a written record of initial test to the Contracting Officer.

3.4 CLEANING

Clean aluminum and stainless steel doors in accordance with manufacturer's approved instructions.

-- End of Section --

SECTION 08 33 23

OVERHEAD COILING DOORS
07/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures, Including Supplement No. 1

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

ASHRAE FUN IP	(2005) Fundamentals Handbook, I-P Edition

ASME INTERNATIONAL (ASME)

ASME B29.400	(2001) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(2005) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2006a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 924/A 924M	(2006) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 2000	(2006a) Standard Classification System for Rubber Products in Automotive Applications
ASTM E 2074	(2000e1) Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 568M	(2004) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2006) Standard for Motors and Generators
NEMA ST 1	(1988; R 1997) Standard for Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 80	(2006) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)

UL 674	(2003; Rev thru Apr 2006) Standard for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations

UL Bld Mat Dir (2006) Building Materials Directory

1.2 DESCRIPTION

Overhead coiling doors to be counterbalanced doors by methods of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members. Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated.

Fire-rated door assemblies must bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for the rating listed on the drawings. Provide a permanent label for each door showing the manufacturer's name and address and the model/serial number of the door.

Oversized fire-rated door assemblies must be provided with a listing agency oversize label, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure as indicated and at least 0.960 kilopascal with a maximum deflection of 1/120 of the opening width. Provide test data showing compliance with ASTM E 330. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested Complete assembly must meet or exceed the requirements of ASCE/SEI 7-05.

1.3.2 Fire-Rated Doors, Frames, and Hardware

Provide fire-rated doors, frames, and hardware which are tested, rated, and labeled in accordance with Underwriters Laboratories, Factory Mutual or Warnock Hersey. The doors, frames, and hardware must bear metal UL labels as evidence of the fire resistance rating, as tested under ASTM E 2074. The labels must indicate the rating in hours, per NFPA 80 of duration of exposure to fire, with a letter following the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed face of the door at the end of 30 minutes of fire exposure.

Provide and attach metal UL labels to each item of hardware in accordance with requirements specified in the UL Bld Mat Dir.

1.3.3 Oversized Coiling Fire-rated Door Assemblies

Where fire-rated doors and frames exceed the size for which testing and labeling services are offered, furnish certificates of inspection from the UL, Factory Mutual or Warnock Hersey. State within certificates that except for size; doors, frames, and hardware are identical in design, materials, and construction to a door that has been tested and rated..

1.3.4 Operational Cycle Life

All portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue must be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for 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

Provide fabrication drawings that show complete assembly with hardware and framing details for the following items:

Overhead Coiling Doors; GA
Counterbalancing Mechanism
Manual Door Operators
Bottom Bar
Guides
Mounting Brackets
Overhead Drum
Hood
Painting

Submit Installation Drawings in accordance with paragraph entitled, "Overhead Coiling Door Assemblies," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items listing all accessories including supports, locks and latches, and weather stripping.

Overhead Coiling Doors; GA
Hardware
Counterbalancing Mechanism
Manual Door Operators
Fire-Rated Door Assembly

SD-05 Design Data

Submit equipment and performance data for the following items in accordance with the paragraph entitled, "Performance Requirements," of this section.

Overhead Coiling Doors; GA
Hardware
Counterbalancing Mechanism
Manual Door Operators
Fire-Rated Door

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies , including the following items:

Materials
Devices
Procedures
Manufacture's Brochures
Parts Lists
Cleaning

1.5 OVERHEAD COILING DOOR DETAIL SHOP DRAWINGS

Provide installation drawings for overhead coiling door assemblies which show elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, and details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Include a schedule showing the location of each door with the drawings.

Contractor must submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Provide test data that is legible and of good quality.

1.6 WARRANTY, OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Materials
Devices
Manual Door Operators
Hood
Counterbalancing Mechanism
Painting
Procedures
Manufacture's Brochures
Parts Lists

Contractor must furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship and that they will remain so for not less than two years after completion and acceptance of the project.

Contractor must warrant that upon notification by the Government, he will immediately make good any defects in material, workmanship, and door operation within the same time period covered by the guarantee, at no cost to the Government.

1.7 DELIVERY AND STORAGE

Delivered doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 OVERHEAD COILING DOORS

2.1.1 Curtain Materials and Construction

Provide curtain slats which are fabricated from steel sheets conforming to ASTM A 653/A 653M, Grade A, with the additional requirement of a minimum yield point of 228 Megapascal. Provide sheets which are galvanized in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Provide slats which are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces on interior surface of slats.

2.1.2 Insulated Curtains

Form Curtains from manufacturer's standard shapes of interlocking slats. Supply slat system with a minimum R-value of 4 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a urethane core not less than 17 mm thick, completely enclosed within metal facings. Exterior face of slats must be the same gauge as specified for curtains. Interior face must be not lighter than 0.56 mm. The insulated slat assembly is to have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.3 Curtain Bottom Bar

Curtain bottom bars must be pairs of angles from the manufacturer's standard steel, stainless and aluminum extrusions not less than 50 by 50 millimeter by 4.8 millimeter. Steel extrusions must conform to ASTM A 36/A 36M. Stainless steel extrusions conforming to ASTM A 666, Type 304. Aluminum extrusions conforming to ASTM B 221 or(ASTM B 221M). Galvanize angles and fasteners in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M. Coat welds and abrasions with paint conforming to ASTM A 780.

2.1.4 Locks

Provide end and/or wind locks of cast steel conforming to ASTM A 27/A 27M, Grade B; galvanized in accordance with ASTM A 653/A 653M, ASTM A 153/A 153M and ASTM A 924/A 924M and secured at every other curtain slat.

2.1.5 Weather Stripping

Weather-stripping at the door-head and jamb must be 3.2 millimeter 1/8-inch thick sheet of natural or neoprene rubber with air baffles, secured to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 15.9 millimeter 5/8-inch wide and 3.2 millimeter 1/8-inch thick.

Threshold weather-stripping must be 3.2 millimeter 1/8-inch thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D 2000.

2.1.6 Locking Devices

Slide Bolt to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Locking Device Assembly which includes cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.1.7 Overhead Drum

Fabricate drums from nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.2 HARDWARE

All hardware must conform to ASTM A 153/A 153M, ASTM A 307, ASTM F 568M, and ASTM A 27/A 27M.

2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for track adjustment.

2.2.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's standard steel shapes and plates conforming to ASTM A 36/A 36M, galvanized in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M. Size the shapes and plates in accordance with the industry standards for the size, weight, and type of door installation..

2.3 COUNTERBALANCING MECHANISM

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.3.1 Brackets

Provide the manufacturer's standard mounting brackets of either cast iron or cold-rolled steel with one located at each end of the counterbalance barrel conforming to ASTM A 48/A 48M.

2.3.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A 53/A 53M, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 2.5 mm per meter 0.03 inch per foot of span under full load.

2.3.3 Spring Balance

One or more oil-tempered, heat-treated steel helical torsion springs installed within the barrel capable of producing sufficient torque to assure easy operation of the door curtain. Provide and size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

2.3.4 Torsion Rod for Counter Balance

Fabricate rod from the manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

2.4 MANUAL DOOR OPERATORS

2.4.1 Manual Push-Up Door Operators

Equip door with manufacturer's recommended lifting handles, locks, and latches. Adjust counterbalance mechanisms so that the required lift or pull for operation does not exceed 11 kilogram 25 pounds unless another type of door operator is indicated. Design operating mechanisms so that the curtain can be stopped at any point in its upward or downward travel and will remain in that position until pushed to the fully open or closed position.

2.5 FIRE-RATED DOOR ASSEMBLY

2.5.1 Fire Ratings

Provide fire-rated door assemblies complying with NFPA 80 Standard for Fire Doors and Other Opening Protectives and UL Fire Resistance - Volume 3.

2.6 SURFACE FINISHING

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 GENERAL

Install overhead coiling door assembly, anchors and inserts for guides, brackets, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, doors must be free from all distortion.

Install overhead coiling doors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors, in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 FIELD PAINTED FINISH

Steel doors and frames which are to be field painted must accordance with Section 09 90 00 PAINTS AND COATINGS and manufacturer's written instructions. Protect weather stripping from paint. Finishes must be free of scratches or other blemishes.

3.3 ACCEPTANCE PROVISIONS

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test and make final adjustment of new doors at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, the Contractor must examine, lubricate, test, and re-adjust doors as required for proper operation.

3.3.2 CLEANING

Clean doors in accordance with manufacturer's approved instructions.

-- End of Section --

SECTION 08 34 63

DETENTION HOLLOW METAL FRAMES, DOORS, AND DOOR FRAMES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M	(2006b) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 366/A 366M	(1997e1) Standard Specification for Commercial Steel, Sheet, Carbon,(0.15 Maximum Percent Cold-Rolled
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM G 60	(2001; R 2007) Conducting Cyclic Humidity Exposures

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 863	(2004) Guide Specifications for Detention Security Hollow Metal Doors and Frames

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Detention hollow metal doors and frames; GA

Submit details at not less than 1/4 full size for each frame type, and elevations of door design type at 1:50 minimum, show conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Indicate fabrication, erection, anchorage, and accessory items.

Submit a schedule listing the location of each door and frame using indicated reference numbers for details and openings shown.

SD-03 Product Data

Detention hollow metal doors and frames

Submit manufacturer's material and fabrication specifications.

SD-06 Test Reports

Door fabrication

Prior to fabrication, submit test report for reinforced flush door of the type to be provided on this project.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver hollow metal work with packaging to provide protection during transit and job storage as recommended by the manufacturer. Door frames shall be provided with steel spreader angles, temporarily attached to the bottom of both jambs, one on each side of the opening to serve as a brace during shipping and handling. Inspect hollow metal work upon delivery for damage. Store hollow metal units on raised platforms in vertical positions with blocking between units to allow air circulation. Keep stored material covered and protected from damage and rust. Do not cover with plastic or unvented canvas.

1.4 HARDWARE COORDINATION CONFERENCE

Conduct a conference for hardware and hollow metal work prior to submittals for the purpose of coordinating the interface of materials that are furnished by the participants listed. Require that a representative of the entity responsible for each of the following functions attend the conference. Notify the following participants a minimum of 5 working days before the conference:

a. Contractor

b. Hollow metal supplier and installer

c. Detention hollow metal supplier and installer

d. Hardware supplier

e. Hardware installer

f. Detention hardware supplier

g. Detention hardware installer

h. Remote control operator and locking device supplier and installer

i. Electrical contractor.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Hot-Rolled Carbon Steel

ASTM A 1011/A 1011M, commercial quality, 14 gage and thicker.

2.1.2 Cold-Rolled Carbon Steel

ASTM A 366/A 366M, commercial quality, stretcher level sheets, 12 gage.

2.1.3 Galvanized Steel

ASTM A 653/A 653M, CQ, mill phosphatized tested by ASTM G 60.

2.2 DETENTION HOLLOW METAL DOORS AND FRAMES

2.2.1 Door Fabrication

a. Provide doors fabricated of cold rolled, pickled and oiled stretcher leveled steel sheets with clean smooth surfaces. Gages shall be as indicated for each type of door. Form molded members straight with joints coped or mitered, and in true alignment. Welded joints on exposed surfaces shall be dressed smooth, to be invisible. Doors shall be custom made full flush design, internally reinforced, sound deadened and insulated, 50 mm thick to receive detention locks, of the elevations, types and sizes shown on the approved shop drawings and schedules.

b. Face sheets shall be mild steel fully welded on edges with continuous inner-reinforcements full height and width. Provide internally 10 gage steel channel banding around complete door perimeter, spot welded to face sheet 75 mm on center. Inner reinforcements shall be truss design with triangular form, or interlocking channels with "Z" bar stiffeners, the shape of which cannot be altered without changing the length of the sides. Flat apexes shall be resistance spot welded on 70 mm centers horizontally and 75 mmcenters vertically. Insulate each flute of reinforcement with 96 kg/cubic meter density rock wool.

c. Bevel vertical door edges 3 mm in 50 mm and internally reinforced full length with 3 mm thick steel channels spot welded not over 75 mm on center inside both door faces. Close top and bottom door edges with continuous recessed 10 gage channels extending the full width of the door and welded 75 mm on center maximum to both faces and continuously welded to the vertical door edge channels to form a single perimeter frame inside the door. Top and bottom edges of doors shall be finished flush, except for provisions for weatherproofing. Mortise, reinforce, drill and tap door edges to receive templated specified hardware in accordance with the approved hardware schedule and the hardware manufacturer's recommendations for the proper installation of hardware and detention equipment.

d. Clearances shall be coordinated with frame and in accordance with NAAMM HMMA 863, Part 2, Section 2.02.

e. Doors shall be free from warpage, wind or buckle. Bends shall be of minimum radius for the gage of metal used.

f. The removable glass stop shall consist of 10 gage angle securely fastened to the frame using machine screws (6 mm #20UNRC: 25 mm at 150 mm on center and no more than 100 mm from corners). Exposed screw heads shall be button head type, and shall be torx fitting tamperproof. The finished glass stop shall be tight fitting and mitered at the corner joints. There shall be a minimum 25 mm glass engagement.

2.2.2 Door and View Window Frame Fabrication

a. Custom-made, fully assembled, factory-welded units of the size and shapes shown on the approved shop drawings. "Knock-down" frames will not be accepted. Coordinate frame dimension to thickness of door or glass.

b. Strong, rigid, neat in appearance, and free from defects. Frame members shall be clean cut, straight, and of uniform profile.

c. Form frames to provide mitered trim and butted stops. Join head and jamb members by continuous welds occupying the full depth and width of the frame. Grind exposed welds smooth and flush.

d. When frames are for door light or food pass, fabricate members as closed tubular shapes having no visible seams or joints on exposed surfaces. Grind exposed welds smooth and flush.

e. Frames over 1200 mm wide installed in masonry partitions shall have a channel stiffener not less than 13 gage welded into the head at the factory.

f. Protect cutouts and reinforcements with pressed steel mortar guards on the inside of the frame.

g. Floor anchors formed of not less than 12 gage steel shall be securely welded to the bottom of each jamb.

h. Frames for installation in masonry walls shall be provided with non-removable adjustable jamb anchors constructed of not less than 14 gage material. Provide jamb anchors at 400 mm on center.

i. Welded frames that are to be installed in previously prepared masonry openings shall be 12 mm smaller in width and 6 mm smaller in height than the masonry opening to provide 6 mm clearance on all sides.

j. When shipping limitations dictate, frames for large openings shall be fabricated in sections designed for field welded splicing. Welds shall be ground smooth and primed for painting. Sections shall be assembled at the factory to ensure proper fit and be clearly marked for field reassembly.

2.2.3 Door Reinforcement for Hardware

a. Mortise, reinforce, drill, and tap doors at the factory for mortised hardware in accordance with the approved hardware schedule and

templates. Doors to receive surface-mounted hardware shall have inner reinforcing plates for drilling and tapping to be performed in the field.

b. For each mortised hinge, provide a reinforcing plate measuring 5 by 38 by 250 mm that is continuously welded inside the edge channel. The top hinge preparation shall be additionally braced by a channel, welded to the back of the hinge reinforcing plate and inside the edge reinforcing channel.

c. Where detention locks are scheduled, provide reinforced pocket to receive locks. The secure side of the door shall be finished flush with a 5 mm backup plate to protect lock. Form the pocket perimeter of 12 gage channels on three sides with the door edge channel completing the perimeter frame. Do not cut the door edge channel except for passage of the lock bolt. Provide a 5 mm thick steel mounting and protection plate to cover the lock pocket and extend at least 20 mm on three sides beyond the cutout. Secure the lock to the protection plate in accordance with the lock manufacturer's instructions. Secure the cover plate to the door by at least six 6 mm security-type machine screws. Make provisions so that removal of the lock is impossible when the lock bolt is extended.

d. Reinforcements for door pulls shall be 5 mm steel welded inside door. Reinforcement size shall be 38 by 250 mm for loop type pull and 150 by 175 mm for flush type pull. Minimum 12 gage reinforcing shall be welded inside the door for all other surface hardware items.

2.2.4 Frame Reinforcement for Hardware

a. Mortise, reinforce, drill, and tap frames at the factory for templated mortised hardware, in accordance with the approved hardware schedules and templates. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates completely drilled and tapped for installation in the field.

b. For each mortised hinge, provide a 7 gage, off-set reinforcing plate that is factory drilled and tapped and measures 38 by 250 mm. Top hinge reinforcement shall be additionally braced by a 7 gage backup angle welded to the reinforcement and to the inside of the frame trim.

c. All other mortised and surface-mounted hardware reinforcements shall be not less than 12 gage.

2.2.5 Factory Finishing

a. After fabrication, dress, fill, and sand tool marks and surface imperfections to make faces and vertical edges smooth, level, and free of irregularities.

b. Surfaces shall be chemically treated and cleansed of rust, oil, and impurities and given a phosphate treatment to ensure paint adhesion.

c. Paint exposed surfaces of doors, and both inside and outside of frames with a minimum of one-mil thickness of rust inhibitive primer

which shall be dried and completely cured to develop hardness before shipment.

2.3 ACCESS PANELS

Provide steel access panels of sizes and locations as indicated and where required for access to utilities, equipment, and controls.

a. Doors shall be 10 gage steel, flanged 32 mm on four sides, with welded corners.

b. Frame shall be composed of steel angles measuring 5 by 50 by 50 mm. Weld and grind joints smooth.

c. Provide detention type hinges with nonremovable pin, three per frame. Weld to door and frames.

d. Weld steel stop angles measuring 3 by 25 by 25 mm to frame on all four sides.

e. Masonry anchors shall be welded at factory, 3 by 25 by 150 mm, minimum four per panel. Provide expansion shields at concrete openings, factory countersunk for 10 mm flathead machine screw, minimum two per jamb.

f. Factory finish with prime coat of rust-inhibitive, baked-on enamel.

g. Provide locks at panels within the security perimeter and points of egress from ducts and tunnels terminating outside the security perimeter. Lock case and cover shall be malleable iron and steel. Bolt shall be high strength bronze and project 20 mm from case when retracted and have a throw of not less than 16 mm. Locks shall have five tumblers, each actuated by phosphor bronze springs. Locks shall operate from one side only. Attach to panel with detention type screws. Locks shall be keyed alike. Enter coded keys into keying system.

2.4 OPENING PROVISION

Speaking ports, view ports, food passes shall be manufactured as indicated.

2.5 SOURCE QUALITY CONTROL

Prior to fabrication, perform the following minimum performance test on a 12 gage reinforced flush door of the type to be provided on this project:

a. Test "A" - Static Load: Under centrally applied load of 62 kN (32 kPa) at quarter points, the maximum permitted deflection shall be 15 mm with a rebound of 0.4 mm after release of load.

b. Test "B" - Rack Test: Under a concentrated load of 33 kN on one unsupported corner of door, the maximum deflection shall not exceed 90 mm without failure.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Door Schedule

Refer to door schedule on drawings for location of doors, door frames, and door hardware.

3.1.2 Frames

Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After completing wall construction, remove temporary braces and spreaders. Do not use any part of the frame as lintels or load-carrying members. Anchor frame to masonry with flat head security type machine screws into expansion shields or attached to a pre-set rough buck anchored to the masonry in the same way. Install five anchors on each jamb for doors up to and including 2250 mm in height and six on each jamb for taller doors.

3.1.3 Doors

Fit hollow metal doors accurately in frames. Provide metal shims where necessary.

3.1.4 Access Panels

Prepare openings as required to receive frame. Use fasteners as specified and required by type of surrounding construction. Ensure that frames are properly seated into opening with steel shims and that doors are true, in alignment, and completely flush in appearance. Maintain 3 mm maximum clearance between door and frame.

3.2 ADJUSTMENT AND CLEANING

Remove and replace defective work which is warped, bowed, or otherwise damaged. Adjust hollow metal work for smooth operation. Touch up scratches and bare edges in the field with a rust inhibiting primer prior to painting.

-- End of Section --

SECTION 08 52 00

WOOD WINDOWS
07/06

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(2005) Standard Specification for Windows, Doors, and Unit Skylights
AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM D 1784	(2006a) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM D 3656	(2004) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D 6007	(2002) Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
ASTM D 6330	(1998; R 2003) Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions

ASTM E 1333	(1996; R 2002) Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products

FOREST STEWARDSHIP COUNCIL (FSC)

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

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2004) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004	(1987; R 1998) Aluminum Tubular Frame Screens for Windows

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

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

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

U.S. GREEN BUILDING COUNCIL (USGBC)

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

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 4	(2000) Water-Repellent Preservative Non-Pressure Treatment for Millwork

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

Wood windows; G

Indicate elevations of units, full-size sections, fastenings, methods of installation and anchorage, method of glazing, locations of operating hardware, mullion details, method and material for weatherstripping, bar and muntin layouts if any, method of attaching insect screens, details of installation, and connections with other work.

SD-03 Product Data

Wood windows; G

Documentation for Energy Star Qualifications.

SD-08 Manufacturer's Instructions

Wood windows

Submit manufacturer's written instructions for installation.

SD-10 Operation and Maintenance Data

Wood windows, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.3 DELIVERY AND STORAGE

Deliver windows to site in sealed undamaged cartons or in palletized multiple units. Protect from damage, dampness and extreme temperature or humidity changes. Store under cover in well-ventilated enclosed space. Do not store in a building under construction until concrete, masonry, and plaster are dry. Replace defective or damaged windows.

PART 2 PRODUCTS

2.1 WOOD WINDOWS

Wood windows shall consist of complete units including sash, glass, frame, weatherstripping, insect screen, and hardware. Window units shall meet the Grade 40 requirements of AAMA 101, except maximum air infiltration shall not exceed 0.00016 cu m per second of sash crack when tested under uniform static air pressure difference of 75 pascals. Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum

of 0.30 determined according to NFRC 200 procedures and a U-factor maximum of 1.8737 W per square m x K in accordance with NFRC 100. In addition to general hardware requirements of AAMA 101, provide hardware for various window types as indicated below. Plexiglass and glazing materials shall conform to Section 08 81 00 "GLAZING". For good sash insulation performance, preference shall be given to engineered wood core clad in wood veneer or PVC-wood composite (uninsulated), using post-industrial wood fiber and 100 percent post-consumer HDPE plastic. Wood members which will receive transparent finish shall be in one piece, not finger-jointed.

2.1.1 Awning Windows (Top Hinged)

Awning window ventilators in same bay shall operate separately. Provide two or more hinges, pivots, or sash-supporting arms for each operative sash to allow easy operation, substantial support and cleaning of both sides of sash from inside. Provide latches for securing each sash if operating devices do not include locking features. Provide operating devices for controlling position of sash, including full open, tight close, and intermediate firm hold. Operating devices shall include rotary operators of worm-gear type with wear-resistant and impact-resistant gears or lever operators of lever handle, off-set arm type. Venting sash shall have corrosion resistant steel hinges connected to top and bottom rails of sash. When lever operators are used, operating arms shall be adjustable so that even sash edge contact can be maintained. Provide compression-type weatherstripping.

2.1.2 Casement Windows

Provide two or more hinges, pivots, or sash-supporting arms for each operative sash to allow easy operation, substantial support and cleaning of both sides of sash from inside. Provide latches for securing each sash if operating devices do not include locking features. Provide operating devices for controlling the position of the operative sash, including full open, tight close, and intermediate firm hold. Operating devices shall include rotary gears and adjustable operating arms so that even sash contact can be maintained. Provide compression-type weatherstripping.

2.2 ACCESSORIES

2.2.1 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.2 Fasteners

Fabricated from 100 percent re-melted steel.

2.3 FINISHES

2.3.1 Paint

Furnish windows with factory-primed surfaces which will be exempt from first paint coat application required in Section 09 90 00 PAINTS AND COATINGS.

2.4 INSECT SCREENS

ASTM D 3656, Class 2, 18 by 14 mesh, color grey. Aluminum frames to meet SMA 1004.

2.5 SASH POLES AND SPECIAL OPERATORS

For windows having operating hardware or locking or latching devices located more than 1800 mm above the floor, provide suitably designed operators or locking or latching devices necessary for convenient and proper window operation.

2.5.1 Pole Operators

Poles shall be of proper length to permit window operation from 1500 mm above the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

2.5.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 1800 mm above the floor. Provide one removable handle for each room.

2.5.3 Sash Poles

Seamless aluminum tube, 1.59 mm minimum wall thickness, 25 mm diameter, 3 m long, with cast aluminum hook and protective cover or tip on the lower end. Finish shall match windows.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wood Windows

Install in accordance with the approved installation instructions. Securely anchor windows in place. Install and seal windows in a manner that will prevent entrance of water and wind.

3.1.2 Insect Screen

Install screen panels in accord with manufacturer's instructions. Install aluminum framed screens in accord with SMA 1004.

3.2 ADJUSTMENTS

Make final adjustment for proper operation of ventilating unit after glazing. Make adjustments to operating sash or ventilators to assure smooth operation. Units shall be weathertight when locked closed. Verify products are properly installed, connected, and adjusted.

3.3 CLEANING

Clean windows on both exterior and interior in accordance with manufacturer's recommendations.

3.4 WASTE MANAGEMENT

Separate corrugated cardboard and protective materials in accordance with the Waste Management Plan and reuse or recycle. Place materials defined as hazardous or toxic waste in designated containers and dispose of properly. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperature. Place used sealant tubes and containers in areas designated for hazardous materials and dispose of properly.

-- End of Section --

SECTION 08 56 63

DETENTION AND SECURITY WINDOWS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME B18.6.3	(2003) Machine Screws and Machine Screw Nuts
ASME B18.6.4	(1998; R 2005) Thread Forming and Threaded Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M	(2006b) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 239	(1995; R 2004) Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
ASTM A 627	(2003) Standard Specification for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities
ASTM A 629	(1988; R 1994e1) Standard Specification for Tool-Resisting Steel Flat Bars and Shapes for Security Applications
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 90/A 90M	(2007) Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM B 766	(1986; R 2003) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

STEEL WINDOW INSTITUTE (SWI)

SWI AGSW	(2002) Architect's Guide to Steel Windows

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

Window units

Indicate the elevations of windows, half-size sections, thicknesses and gages of metal, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, method of glazing, mullion details, casings, sills, trim, other related items, and installation details.

SD-03 Product Data

Window units

Fasteners

Accessories

Include finishes.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver windows to project site in an undamaged condition. Store windows and components at the site on edge, out of contact with the ground, and under a weathertight covering.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Bars

SWI AGSW.

2.1.2 Sheet Steel

ASTM A 1011/A 1011M.

2.1.3 Zinc-Coated Sheet Steel

ASTM A 653/A 653M.

2.1.4 Zinc-Coated Steel

ASTM A 90/A 90M, ASTM A 123/A 123M or ASTM A 153/A 153M.

2.1.5 Corrosion Resisting Sheet Steel

ASTM A 167.

2.1.6 Screws and Bolts

ASTM B 766, ASME B18.6.3, or ASME B18.6.4, as applicable.

2.2 WINDOW UNITS

Units shall conform to the SWI AGSW, except as modified herein.

2.3 FABRICATION

Form permanent joints by welding or by mechanically fastening as specified for each type window. Use joints of strength required to maintain the structural value of members connected. Weld joints solid, remove excess metal, and dress smooth on exposed and contact surfaces. Closely fit joints formed with mechanical fastenings and make permanently watertight. Assemble frames at the plant, and ship as a unit with hardware unattached.

2.3.1 Window Sections

Where fixed window sections adjoin, provide a fixed sash, fabricated from similar frame members and of the manufacturer's standard type suitable for the purpose. Roll weathering surfaces integrally to provide two-point, parallel-surface contact with an overlap at both inside and outside points of closure.

2.3.2 Drainage Holes

Provide drips and weep holes, as required, to return water to outside, minimum of two per window.

2.3.3 Fasteners

Use flat or oval head spanner, twist-off or safety head screws and bolts with standard threads on windows, trim and accessories. Self tapping sheet-metal screws are not acceptable.

2.3.4 Fastener Finish

Fabricate windows with hot-dipped galvanized finish, using stainless steel or hot-spun galvanized steel fasteners. Use heavily cadmium plated steel fasteners for windows with painted finish or electrogalvanized in accordance with ASTM A 239. Finish exposed heads of fasteners to match finish of windows.

2.3.5 Frames

Form frames from low carbon steel not less than 12 U.S. gage. Frames shall be one piece, channel shaped sections, at each jamb and between jamb at head and sill. Cope or miter and weld frame members at corners full depth of the frame for maximum strength and weathertightness; dress exposed welds smooth. Provide frame members with dimensions and profiles indicated. Provide 20 by 57 mm, tool resistant steel flats conforming to ASTM A 629, penetrated by 22 mm tool-resistant steel rounds conforming to ASTM A 627 in frame members.

2.4 PROVISIONS FOR GLAZING

Design for outside single glazing and for securing plexiglass with metal beads and glazing compound as specified in Section 08 81 00 GLAZING.

2.5 SCREENS

Provide manufacturer's standard screens for window units with movable sash, galvanized frame.

2.6 ACCESSORIES

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation of windows.

2.7 ANCHORS

Use hot-dip, zinc-coated steel anchors of the type indicated or specified. Use cadmium or zinc-coated nuts, bolts, and other fasteners for ferrous material.

2.8 SHOP PRIMED FINISH

After fabrication, clean surfaces of windows, fins, mullions, cover plates and screen frames, provide a hot-dip galvanized, phosphate-treated and shop primed finish. The methods of cleaning, chemical treating, galvanizing, and painting shall conform to SWI AGSW. Windows shall receive finish paint coats as specified in Section 09 90 00 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Install windows in accordance with the manufacturer's printed instructions and details, except as specified otherwise in this section. Build in windows as the work progresses. Set windows at indicated elevation, location, and reveal. Set plumb, square, level, and in alignment. Brace, strut, and stay to prevent distortion and misalignment.

3.2 ANCHORS AND FASTENINGS

Place anchorage as wall construction progresses. Build in anchors or bolt anchors and fastenings to the jambs of openings and weld securely to the windows or frames and to the adjoining construction. Space anchors not more than 400 mm apart on jambs, and install a minimum of four anchors on each side of each opening. Anchors and fastenings shall have sufficient strength to hold the member firmly in position.

3.3 SEALANTS

Section 07 92 00 JOINT SEALANTS.

3.4 CLEANING

Clean metal surfaces of windows, inside and outside, of mortar, plaster, paint, and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces. Clean and touch-up abraded surfaces of steel windows. Replace stained, discolored, or abraded windows that cannot restored to their original condition with new windows.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to 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	(2004) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2006) Butts and Hinges
BHMA A156.13	(2005) Mortise Locks & Latches, Series 1000
BHMA A156.15	(2006) Closer Holder Release Devices
BHMA A156.16	(2002) Auxiliary Hardware
BHMA A156.18	(2006) Materials and Finishes
BHMA A156.2	(2003) Bored and Preassembled Locks and Latches
BHMA A156.21	(2006) Thresholds
BHMA A156.22	(2005) Door Gasketing and Edge Seal Systems
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(2001) Auxiliary Locks & Associated Products
BHMA A156.6	(2005) Architectural Door Trim
BHMA A156.7	(2003) Template Hinge Dimensions
BHMA A156.8	(2005) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2006) Life Safety Code, 2006 Edition

NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003) Recommended Specification for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 14C	(2006) Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Hardware schedule; G

Keying system

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard-ware Item	Quan-tity	Size	Reference Publi-cation Type No.	Finish	Mfr. Name and Catalog No.	Key Con-trol Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designa-tion

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.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to 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." Conform to UL 14C for swinging hardware for the tin-clad fire doors. Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, 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

BHMA A156.1, size as indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges. There shall be at least 3 hinges at each door. Each hinge shall be at least 200/16/5 MM, secured with threaded pins.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 178 by 57 mm with a bushing at least 6 mm long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.2.2 Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 1.

2.3.2.3 Residential Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 2. Install locks for exterior doors with threaded roses or concealed machine screws.

2.3.2.4 Auxiliary Locks

BHMA A156.5, Grade 1.

2.3.3 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide escutcheons, not less than 178 by 57 mm.

2.3.4 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets have 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.

2.3.5 Keying System

Provide a master keying system. Provide a construction master keying system. Provide key cabinet as specified.

2.3.6 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.6.1 Lever Handles

Provide lever handles in lieu of knobs. Conform to the minimum requirements of BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 13mm.

2.3.7 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish two additional keys for each sleeping room. Furnish 2 construction master keys, and 2 control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.8 Closers

BHMA A156.4, Series C02000, and Series C02061, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.8.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.9 Overhead Holders

BHMA A156.8.

2.3.10 Closer Holder-Release Devices

BHMA A156.15.

2.3.11 Door Protection Plates

BHMA A156.6. Door protection plates shall be stainless steel with smooth sanded surface, grain 240. Plates shall be fastened with glue and stainless steel screws.

2.3.11.1 Sizes of Mop Plates

Fifty mm less than door width for single doors; 25 mm less than door width for pairs of doors. Provide 150 mm mop plates.

2.3.11.2 Sizes of Kick Plates

Kick plates shall be full width of the door and 300 MM high. Kick plates shall be provided on both sides of the doors.

2.3.12 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair. Door stops shall be heavy-duty stainless steel post with skid nose made of white nylon. Length of stops shall be sufficient to prevent door handles from striking wall.

2.3.13 Thresholds

BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.14 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 2.19 x 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:

2.3.14.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear anodized aluminum.

2.3.14.2 Interlocking Type

Zinc or bronze not less than 0.45 mm thick.

2.3.14.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.20 mm thick.

2.3.15 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, clear anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.15.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.15.2 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.

2.3.16 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

BHMA A156.18. Provide hardware in heavy duty commercial grade stainless steel unless specified otherwise.

2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

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.

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 38 mm on center.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 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.

3.3 KEY CABINET AND CONTROL SYSTEM

Locate where directed by Contracting Officer. 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.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS

Refer to Architectural Drawings for Hardware Sets.

-- End of Section --

SECTION 08 81 00

GLAZING
07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C 1184	(2005) Standard Specification for Structural Silicone Sealants
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(2005) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 395	(2003) Standard Test Methods for Rubber Property - Compression Set
ASTM D 4802	(2002) Poly(Methyl Methacrylate) Acrylic Plastic Sheet
ASTM D 673	(1993ae1) Mar Resistance of Plastics
ASTM E 119	(2007) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 2010	(2001) Positive Pressure Fire Tests of Window Assemblies

ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 413	(2004) Rating Sound Insulation
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual
GANA Sealant Manual	(1990) Sealant Manual
GANA Standards Manual	(2001) Tempering Division's Engineering Standards Manual

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2004) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2003) Standard Methods of Fire Tests of Door Assemblies
NFPA 257	(2006) Fire Test for Window and Glass Block Assemblies
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2003, 2007 e1) DOD Minimum Antiterrorism Standards for Buildings

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-378	(Basic; Notice 1) Putty Linseed Oil Type, (for Wood-Sash-Glazing

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Rev thru Dec 2006) Bullet-Resisting Equipment
UL MEAPD	(2003) Mechanical Equipment and Associated Products Directory

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of plastic glazing.

SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Plastic Sheet

Glazing Compound

Glazing Tape

Sealant

Two 203 x 254 mm samples of each of the following: plastic sheet and insulating glass units.

SD-07 Certificates

Plastic Glazing

Certificates stating that the plastic glazing meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Glazing Accessories

SD-08 Manufacturer's Instructions

Setting and sealing materials

Plastic Glazing setting

Submit plastic glazing manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified. Include cleaning instructions for plastic sheets.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without plastic glazing breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store plastic glazing and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 4 degrees Cand rising, unless procedures recommended by the plastic glazing manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 WARRANTY

1.6.1 Warranty for Plastic Glazing Units

For five year period following acceptance of the work: Warranty Type I, category A (UV stabelized) sheets against breakage.

For ten year period following acceptance of the work: Warranty Type IV, against yellowing and loss of light transmission.

PART 2 PRODUCTS

2.1 MIRRORS

2.1.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6 mm (1/4 inch) thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint, and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.2 One-Way Laminated Vision Glass (Transparent Mirrors)

Type I, Class 1, Quality q1, 6 mm thick, coated on one face with a hard, adherent film of chromium or other approved coating of equal durability. Glass shall transmit not less than 5 percent or more than 11 percent of total incident visible light and shall reflect from the front surface of the coating not less than 45 percent of the total incident visible light.

2.2 PLASTIC GLAZING

2.2.1 Plexiglas G - Acrylic Sheet

ASTM D 4802, Category A-1, Finish 1 (architectural glasing clear and smooth on both sides), Finish 3 (abrasion resistant mylar coated for guard tower), Type UVF ultraviolet stabilized, heat resistant, 8 mm thick.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Putty and Glazing Compound

Putty shall be linseed oil type conforming to CID A-A-378for face-glazing primed wood sash.

2.3.2 Sealants

Provide elastomeric and structural sealants.

2.3.2.1 Elastomeric Sealant

ASTM C 920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, and with plastic sheet. Color of sealant shall be white.

2.3.2.2 Structural Sealant

ASTM C 1184, Type S.

2.3.3 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.3.4 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. Channels shall be chemically compatible with plastic sheet.

2.3.5 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D 2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.6 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C 509 and ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by plastic glazing manufacturer. Block color shall be black.

2.3.7 Glazing Gaskets

Neoprene or DPDM glazing gaskets shall be extruded with continuous integral locking projection designed to engage into plastic glazing holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.3.7.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.3.7.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.3.8 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.4 MIRROR ACCESSORIES

2.4.1 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 32 x 6 x 6 mm (1-1/4 x 1/4 x 1/4 inch) continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the plastic glazing. Grind smooth in the shop plasstic glazing edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing plastic glazing as soon as plastic glazing is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 PLASTIC GLAZING SETTING

Shop glaze or field glaze items to be glazed using plstic glazing of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Handle and install glazing materials in accordance with manufacturer's instructions. Use channel frames, beads or stops which are furnished with items to be glazed to secure the plastic glazing in place and allow glazing to expand and contract freely. The channel frame shall be deep enough for the plastic glazing to contract freely and stay within the frame. Tapes and sealants that adhere to both plastic glazing and the frame shall be sufficiently extensible to accomodate thermal expansion of both. Verify products are properly installed, connected, and adjusted.

3.2.1 Plastic Sheet

Conform to manufacturer's recommendations for edge clearance, channel frames, type of sealant and tape, and method of installation.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted. Clean plastic sheet in accordance with manufacturer's instructions.

3.4 PROTECTION

Plastic glazing work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Upon removal, separate protective materials for reuse or recycling. Plastic glazing units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

SECTION 09 22 00

METAL SUPPORT ASSEMBLIES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(2006) Nonstructural Steel Framing Members
ASTM C 754	(2004) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(2003) Installation of Interior Lathing and Furring

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM ML/SFA 920	(1991) Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2007) Fire Resistance Directory Set

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

Metal support systems; G

Submit for the erection of metal framing, 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 A 653/A 653M, Z180; aluminum coating ASTM A 463/A 463M, T1-75; or a 55-percent aluminum-zinc coating.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841.

2.1.1.2 Nonload-Bearing Wall Framing

NAAMM ML/SFA 920.

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 Nonload-Bearing Wall Framing

NAAMM ML/SFA 920, except that framing members shall be 400 mm o.c. unless indicated otherwise.

3.2 ERECTION TOLERANCES

Framing members which will be covered by finish materials such as plaster, or ceramic tile set in a mortar setting bed, shall be 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.

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:

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 37.00 10

LATHING AND PLASTERING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 580/A 580M	(2006) Standard Specification for Stainless Steel Wire
ASTM A 853	(2004) Standard Specification for Steel Wire, Carbon, for General Use
ASTM B 164	(2003) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 1002	(2004) 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 1032	(2006) Standard Specification for Woven Wire Plaster Base
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 29/C 29M	(1997; R 2003) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 472	(1999; R 2004) Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
ASTM C 61/C 61M	(2000) Gypsum Keene's Cement
ASTM C 645	(2006) Nonstructural Steel Framing Members
ASTM C 754	(2004) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(2003) Installation of Interior Lathing and Furring
ASTM C 847	(2006) Standard Specification for Metal Lath

ASTM C 897	(2000) Aggregate for Job-Mixed Portland Cement-Based Plasters
ASTM C 926	(2006) Application of Portland Cement-Based Plaster
ASTM C 933	(2005) Welded Wire Lath
ASTM C 955	(2006) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases

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

Approved Detail Drawings; G

Drawings including installation details, ceiling framing, and furring.

SD-03 Product Data

Lathing Installation; G

Manufacturer's pre-printed descriptive data, catalog cuts, and installation instructions for plastering materials and accessories.

SD-04 Samples

Portland Cement Plaster

One 1 m square sample panel of each specified finish.

SD-07 Certificates

Qualifications

Manufacturer's experience in specified work.

1.3 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified, and shall have a minimum of 5 years of documented successful experience. Applicator shall specialize in the type of lath and plaster work required to meet requirements, with a minimum of 3 years of documented experience.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to project site in the original containers bearing the name of manufacturer, contents, and brand name. Plaster, cement, and lime shall be stored off the ground under weathertight cover and away from sweating walls and other damp surfaces until ready for use. Accessories shall be stored off the ground in a weathertight structure for protection. Damaged or deteriorated materials shall be removed from project site.

1.5 ENVIRONMENTAL CONDITIONS

A temperature between 4 and 27 degrees C shall be evenly maintained in the building for a period of not less than 1 week prior to application of plaster, and for a period of at least 1 week after the gypsum plaster is set, in accordance with ASTM C 842. Interior spaces shall be ventilated in accordance with ASTM C 842 immediately after applying plaster.

PART 2 PRODUCTS

2.1 NON-LOADBEARING WALLS

2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll-formed steel with minimum uncoated design thickness of 0.72 mm<ENG> 0.0284 inch</ENG> made from G40 hot-dip galvanized coated sheet.

2.1.2 Runner Tracks

Prefabricated floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

2.2 METAL WALL FURRING

Metal wall furring channels shall conform to ASTM C 645. Furring channels shall be formed from cold-rolled steel, 19 mm wide by 11 mm deep, made from G40 hot-dip galvanized coated sheet.

2.3 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 1.40 mm thick cold-rolled steel, 38 mmwide by 11 mm deep. Cross furring members shall conform to ASTM C 645, and shall be formed from cold-rolled steel, 19 mm wide by 11 mm deep. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

2.4 TRIM, MOLDINGS, AND ACCESSORIES

2.4.1 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG nominal diameter, conforming to ASTM A 853 or flat

iron or steel straps, at least 2 x 22 mm size, coated with zinc, cadmium, or rust-inhibiting paint.

2.4.2 Fastenings

Tie wire, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B 164, annealed condition. Walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

2.4.2.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG diameter. Tie wire for all other applications shall be not less than No. 16 SWG diameter.

2.4.2.2 Clips

Clips used in lieu of tie wire for securing furring channels to the runner channels in ceiling construction shall be made from strips not less than 3 mm thick or shall be hairpin clip formed of No. 8 SWG wire. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

2.4.3 Expanded Flange Corner Beads

Expanded flange corner beads shall be fabricated of 0.50 mm thick galvanized steel, with 64 mm wide flanges and 3 mm wide bead.

2.4.4 Bullnose Corner Beads

Bullnose corner beads shall be fabricated of 0.50 mm thick galvanized steel, with 64 mm wide flanges and 19 mm bead.

2.4.5 Cornerites

Cornerites shall conform to ASTM C 847. Cornerites shall be fabricated of galvanized expanded metal lath to form an angle of at least 100 degrees, with outstanding legs of not less than 50 mm.

2.4.6 Base or Parting Screed

Base screeds shall be fabricated of 0.50 mm thick galvanized steel, 13 mm depth, with not less than 50 mm wide expansion flanges.

2.4.7 Casing Beads

Casing beads shall be fabricated of galvanized 0.70 mm thick steel 13 mm depth, 25 mm wide expansion wings, front edge of face flange shaved for intended use, back slightly arched to provide a spring effect.

2.4.8 Control Joints

Control joints shall be designed for expansion and contraction of plaster work due to thermal exposure. Control joints shall be fabricated of vinyl (for interior) or galvanized steel (for exterior back to back casing beads).

2.4.9 Reveal Molding

Reveal moldings shall be fabricated of vinyl (for interior) or galvanized steel (for exterior application) or zinc. Reveal molding shall be size and shape as shown.

2.4.10 Screws

Self-drill steel screws shall conform to ASTM C 1002. Screws shall be Type S for use with steel framing and Type W for use with wood members.

2.5 METAL LATH

2.5.1 Expanded Metal Lath

Expanded metal lath shall conform to ASTM C 847. Lath shall be self-furring lath or flat rib lath, expanded from cold-rolled carbon sheet steel of commercial quality, coated with rust-inhibitive paint after fabrication, 1.8 kg/square meter, with backing.

2.6 CEMENT PLASTER MATERIALS

2.6.1 Portland Cement

Portland cement shall conform to ASTM C 150, white portland cement Type II with 13 mm chopped alkali-resistant fiberglass strands or polypropylene fibers, minimum 680 g per sack of cement.

2.6.2 Aggregates

The unit weight of aggregates shall be determined in accordance with ASTM C 29/C 29M. Portland cement based plaster aggregates shall conform to ASTM C 897, except that the gradation of natural or manufactured sand for portland-cement plaster shall be as follows:

Sieve Size (mm)	Sand, Percentage by Weight Retained on Each Sieve Maximum	Minimum
4.75	0	--
2.36	8	2
1.18	38	22
0.60	78	52
0.30	97	65
0.15	100	97

2.6.3 Water

Water shall be clean, fresh, potable, and free from injurious amounts of oils, acids, alkalis and organic matter injurious to the plaster and to any metal in the system.

2.6.4 Lime

Lime shall conform to ASTM C 206, Type S-Special hydrated finishing lime suitable for use in scratch brown and finish coats of portland-cement plaster.

2.7 WALL OPENING FRAMES

Steel frames for wall openings for doors, pass-through openings, and access panels shall be as specified in Section 08 11 13 STEEL DOORS AND FRAMES or Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS. Wood frames, wood bucks, and blocking for wall openings for doors, pass-through openings, and access panels shall be as specified in Section 06 10 00 ROUGH CARPENTRY.

PART 3 EXECUTION

3.1 PREPARATION

Project conditions shall be verified as ready to receive the work. Field measurements shall be verified for compliance with approved detail drawings and manufacturer's published recommendations. Beginning of installation means installer accepts existing conditions.

3.2 SUSPENDED CEILING FRAMING INSTALLATION

Suspended system shall be installed in accordance with ASTM C 841. Where channels are spliced, the ends shall be overlapped not less than 300 mm for 38 mm channels and not less than 200 mm for 19 mm channels with flanges of channels interlocked and securely tied near each end of the splice with two loops of the tie wire. Splices shall be staggered.

3.2.1 Hangers

Wire or strap hangers shall be attached to structural members in accordance with ASTM C 841, except hangers shall be spaced not more than 1220 mm along runner channels and 900 mm in the other direction or 1050 mm in both directions unless otherwise indicated or approved. Locations of hangers shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 150 mm from wall. Hanger wire shall be looped around bottom chord of open-web steel joist or secured to structural elements with suitable fasteners. Sags or twists in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

3.2.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 841. Hanger wire shall be saddle-tied to runner channels, and the end of hanger wires shall be twisted three times around itself. Main runners shall not come in contact with abutting masonry or concrete walls and partitions. Main

runners shall be located within 150 mm of the paralleling wall to support the ends of cross furring.

3.2.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 841 for the type of lath used. Furring channels shall be securely saddle-tied to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent clips or fastenings. Furring channels shall be located within 50 mm of parallel walls and beams, and 13 mm from abutting walls.

3.2.4 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

3.3 FURRED CEILING FRAMING INSTALLATION

Ceiling runners at continuous furred ceilings shall be applied directly to furring channels and secured thereto with tie wire, bolts, or screws at not more than 600 mm centers.

3.4 WALL FRAMING INSTALLATION

3.4.1 Non-Loadbearing Wall Framing

Nonload-bearing steel studs shall be installed in accordance with ASTM C 754 with spacings as indicated in ASTM C 841 for the type of lath used. Studs shall be aligned and secure in top and bottom runners at spacings indicated on drawings. Two beads of acoustic sealant shall be placed between runners and substrate to achieve the required air seal. Stud splicing is not acceptable. Corners shall be constructed with a minimum of three studs. Stud framing system shall be braced and made rigid.

3.4.2 Adjoining Walls and Columns

Studs which adjoin walls or columns shall be secured near the top and bottom, and at least one intermediate point, but not more than 1.5 m on centers, with wire inserts, dovetail anchors, toggle bolts, or bolts set in expansion shields.

3.4.3 Wall Bracing

Partitions more than 3 m long or 2.7 m high shall be braced with 19 mm steel channel stiffeners concealed horizontally. Stiffeners shall be spaced vertically not more than 2 m and shall be secured to each stud. Unsupported partitions 6 m or more in height shall be braced with 38 mm channel type horizontal stiffeners.

3.4.4 Corners and Intersection

Corners and intersections of partitions shall be formed of three studs. Studs at internal corners shall be placed not more than 50 mm from partition intersection.

3.4.5 Wall Openings

One loadbearing metal stud shall be installed at each jamb of door openings continuous from floor to ceiling, and shall be welded to jamb anchors and runner tracks. Jack studs shall be attached to runner track on interior of head of frame, and to runner track or 19 mm channel at ceiling. A 19 mm channel reinforcement shall be placed inside the partition 150 to 200 mm above door openings continuously through two stud spaces on each side of jambs, and welded to the flange. Studs shall be doubled at wall openings, with not more than 50 mm each side of openings. Stud placement shall be coordinated with supports and attachments. Intermediate studs above and below openings shall be secured at same spacing as wall studs. Stud framing shall extend to ceiling or through ceiling as indicated on drawings. Clearance shall be maintained between partition and structure to avoid deflection transfer to studs of partitions which extend through ceiling to structure. Placement of insulation in stud spaces shall be made inaccessible after studs are installed.

3.4.6 Bucks, Anchors and Blocking

Installation of bucks, anchors, and blocking shall be coordinated with electrical and mechanical work to be placed in or behind stud framing, and shall be coordinated with blocking requirements for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware and similar items scheduled for installation.

3.5 WALL FURRING INSTALLATION

Metal furring shall be installed in accordance with ASTM C 754 and ASTM C 841.

3.6 SINGLE/DOUBLE CHANNEL, PARTITION INSTALLATION

Channel studs for single channel and double channel stud partitions shall be spaced 400 mm on centers and shall be secured to ceiling runners and to floor runners or base clips with wire ties or sheet-metal screws. Studs on each side of door openings shall be doubled and stiffened with a 6 x 25 mm flat steel strut, shop-coated with rust-inhibiting paint. Ends of struts shall be bent and punched for bolting to floor and ceiling construction. Where rib metal lath is the plaster base in continuous lengths from ceiling runners to floor runners for partitions less than 3 m in height, steel channel studs may be excluded from the partition except at locations previously specified for door openings. Rib lath shall be firmly attached to ceiling runner tracks or cornerite and to floor runner track or base by wire ties located not more than 200 mm on centers. Studless rib lath partitions shall be limited to not less than 50 mm thick. Partitions shall be as shown.

3.7 LATHING INSTALLATION

3.7.1 Metal Lath on Vertical Surfaces

Metal lath shall be applied with the long dimension across the supports, with true even surfaces, and without sags or buckles in accordance with ASTM C 841. Metal lath on vertical surfaces shall be oriented to provide maximum mechanical bond with plaster and the upper sheet shall be attached to overlap the lower sheet. When paper-backed lath is used, the upper sheet shall be attached to overlap the lower sheet. The lath shall be secured to supports

at intervals not exceeding 150 mm. Nails or staples shall be used for securing lath to wood supports. Tie wires, rings, clips, or other approved fasteners having equivalent holding power of the tie wires shall be used for securing the plaster base to metal supports and to concrete or masonry. Side-laps or junction of sides of plaster base shall be tied or otherwise secured at intervals not exceeding 225 mm between supports, in addition to being secured to supports.

3.7.2 Metal Lath on Ceilings

Metal lath on ceilings shall be in accordance with ASTM C 841. Lath on unrestrained ceilings shall not be turned down at junction with wall or tied to wall lath or furring. Lath on restrained ceilings shall be turned down at junction with wall, or shall be applied to cornerite or corner bead.

3.7.3 Side and End Laps

Side and end laps of metal plaster bases shall be performed in accordance with ASTM C 841 for flat lath and ribbed lath.

3.7.4 Chases and Recesses

Chases and recesses shall be lathed for plastering. Openings over 300 mm wide shall be bridged with furring channels spaced 300 mm on centers. Openings 300 mm wide and less do not need to be bridged. Lath shall extend 75 mm beyond the edges of opening. Lath shall be securely fastened by nailing or tying. Lath shall be securely fastened with nails, screws or wire ties.

3.8 OPENINGS

Reinforcement shall be provided at corners of openings in plastered areas extending 300 mm or more in any dimension by securing striplath diagonally at corners. Striplath shall be at least 150 mm wide by 400 mm long. Shorter lengths shall be used to preclude lapping striplath. Striplath shall be secured to lathing without extending fastenings into or around supporting members. Where plaster is applied directly to concrete or masonry surfaces, striplath shall be secured to the concrete or masonry.

3.8.1 Steel Frames

Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of opening with tie wire, bolts, screws, or welding or bracing where bracing is specified. Steel frames shall be grouted solid with plaster grout and a groove shall be formed within the frame returns to receive lath and plaster.

3.8.2 Ceiling Openings

Framing shall be provided for ceiling openings and supplemental supporting members for items mounted in ceiling or attached to ceiling suspension system. Frames for openings shall be secured to lath support members. Frames provided with expanded metal flanges shall be secured to lath. Intermediate structural members shall be provided for attachment or suspension of support members.

3.8.3 Openings in Hollow Partitions

Hollow partition door openings shall be additionally braced by tying together each set of double-jamb studs with not less than four solid metal column clips evenly spaced along each jamb.

3.8.4 Openings in Partitions Not To Structure

Partitions not extending to the structural ceiling or structural supports or frame shall be strengthened at openings with angle bracing from each jamb location anchored to the structural ceiling or supports.

3.8.5 Cross Bracing

Cross bracing between partitions or similar bracing may be substituted for angle bracing as approved. Minor frames such as those required for access panels may be provided with expanded metal flanges which shall be attached to lath.

3.9 INSTALLATION OF TRIM, MOLDINGS, AND ACCESSORIES

Trim, moldings, and accessories shall be installed in standard lengths level and plumb to straight lines and as indicated on drawings. Fastenings shall be spaced not over 300 mm on centers for single-flanged accessories and not over 600 mm on centers on each flange of double-flanged accessories. Items shall be mitered or coped at corners, or prefabricated corners shall be used. Joints in straight runs shall be formed with splice or tie plates.

3.9.1 Base Screeds

Base screeds shall be installed approximately 75 mm above finished floor elevation unless indicated otherwise.

3.9.2 Corner Beads

Corner beads shall be installed in standard lengths at external plastered corners, and shall be secured to furring members or supports.

3.9.3 Cornerites

Cornerites shall be installed at internal angles formed by abutting surfaces of gypsum lath or metal lath not turned down at horizontal corners or returned around vertical corners. Cornerites shall be secured to lathed surfaces. Cornerites shall be secured to concrete or masonry where plaster is applied directly to concrete or masonry surfaces. Cornerites shall not be installed at unrestrained ceilings.

3.9.4 Casing Beads

Casing beads shall be installed at the joints of dissimilar base materials in the same plane and at exposed edges of plaster including junctions of walls and ceilings except that beads shall not be installed at restrained ceilings abutting plastered surfaces. At the perimeter of unrestrained suspended ceilings, the casing bead shall be secured to the ceiling to provide a 10 mm opening between the abutting surfaces. The opening shall be sealed prior to plastering with sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.9.5 Expansion and Control Joint Beads

Expansion joint beads shall be installed as control joints in plasterwork at the locations indicated. Plaster base shall not be run continuous through control joints. Additional supports shall be installed as required to support the beads.

3.9.6 Trim

Trim shall be installed where indicated and as required to complete the plaster work.

3.10 PLASTER THICKNESS AND SURFACE EVENNESS

Plaster thickness and surface evenness shall be controlled by grounds or screeds of metal, wood, or plaster. Wood grounds are specified under Section 06 10 00 ROUGH CARPENTRY. Plaster thickness shall be as shown.

3.10.1 Grounds and Screeds

Grounds shall be used for securing trim items, and for finished corners and terminations. Screeds shall be installed for base screeds when wood or metal grounds are not required. Temporary screeds shall be installed when permanent screeds or grounds cannot be used. On completion of approved base coats, temporary screeds shall be removed and voids immediately filled with plaster.

3.10.2 Plaster Screeds

Plaster screeds shall be used within the plastered areas to supplement wood and metal grounds and screeds.

3.11 PLASTER GROUT

Plaster grout shall be scratch-coat material mixed to a non-fluid consistency. Plaster grout shall be used to fill steel door frames and partition bases. Heads and jambs of frames shall be filled solid with grout, and 13 mm deep grooves shall be formed in the grout, while plastic, to receive gypsum lath.

3.12 PROPORTIONS AND MIXING

3.12.1 Portland Cement Plaster Base Coat

Base coat shall be proportioned and mixed in accordance with ASTM C 926.

3.12.2 Portland Cement-Plaster Finish

The finish coat shall be proportioned and mixed in accordance with ASTM C 926.

3.13 MACHINE APPLICATION

A plastering machine may be used for the application of scratch and brown coats. Plaster for machine application shall be a special plaster compounded and packaged by the manufacturer for this purpose. Slump cone equipment shall be present on the jobsite when base-coat plastering begins, and until

completion. Testing of the mix shall be the responsibility of the Contractor, but equipment shall be available for use by the Government. Additional water shall not be added to the mix to allow pumping through extended hose lines to the plastering nozzle. The amount of water added to each batch of plaster shall be that quantity which results in a plaster slump of not more than 75 mm for gypsum and 65 mm for portland cement using a standard plaster slump cone or 150 mm for gypsum and 125 mm for portland cement using a concrete slump cone. Application of plaster shall conform to the provisions of ASTM C 842.

3.14 QUALITY CONTROL

Fluidity or stiffness of plaster shall be tested with a standard 50 x 100 x 150 mm plaster slump testing cone or by a 100 x 200 x 300 mm concrete slump testing cone. Method of making slump test shall be as follows:

a. Place cone on center of dry base plate located on a level, firm surface. Hold cone tightly against plate.

b. Fill the cone with plaster obtained from the hose or nozzle, without air on the nozzle, puddling with tamping rod during the operation to eliminate air bubbles or voids.

c. Screed plaster level with top of cone.

d. Lift cone straight up from base plate in a slow and uniform motion, and place it on the base plate next to plaster sample.

e. Lay a straightedge across top of cone, being careful not to disturb or jostle the plate, and measure the slump in mm from the bottom of the straightedge to the top of the plaster sample.

3.15 APPLICATION OF FINISHES

The finish coat may be omitted back of projecting bases, wainscots, structural-glass wall finish, cabinets, chalkboards, tackboards, bulletin boards, acoustic treatments, fixed equipment, and other locations where indicated. Finish coats shall not be applied above wainscots until wainscots have been installed. Plaster shall have a smooth-trowelfinish.

3.15.1 Portland Cement-Based Plaster

Two-coat portland cement-based plaster shall be applied in accordance with ASTM C 926. The final coat shall be finished to a true and even surface free from rough areas, checks, or blemishes. Nominal plaster finish thickness shall be as shown.

3.16 PATCHING

Plaster showing oversanding, cracks, blisters, pits, checks, discoloration or other defects is not acceptable. Defective plaster work shall be removed and replaced with new plaster at the expense of Contractor. Patching of defective work will be permitted only when approved by the Contracting Officer. Patching shall match existing work in texture and color.

3.17 SAMPLES OF COMPLETED WORK

Samples of completed work may be taken by the Contracting Officer at any time for laboratory inspection and tests to determine conformance.

-- End of Section --

SECTION 09 24 23

STUCCO
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2006; E 2006) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1032	(2006) Standard Specification for Woven Wire Plaster Base
ASTM C 1063	(2006) Standard Practice for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 841	(2003) Installation of Interior Lathing and Furring
ASTM C 847	(2006) Standard Specification for Metal Lath
ASTM C 897	(2000) Aggregate for Job-Mixed Portland Cement-Based Plasters
ASTM C 926	(2006) Application of Portland Cement-Based Plaster
ASTM C 933	(2005) Welded Wire Lath
ASTM D 1784	(2006a) 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. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lath

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.

SD-03 Product Data

Materials

Detailed description of the proposed job-mix proportions for base and finish coats; including identification of thickness of coats.

SD-04 Samples

Colored Stucco Finish Coat

Samples including both a fabricated portion of unit of work and color samples.

Sample Panel

Sample panel, as specified.

1.3 DELIVERY AND STORAGE

Packaged materials shall be delivered to the site in the original packages and containers with labels intact and seals unbroken. Cementitious materials shall be kept dry and stored off the ground under cover away from damp surfaces until ready to be used. Aggregate shall be covered to prevent the absorption or loss of moisture.

1.4 ENVIRONMENTAL CONDITIONS

Stucco shall not be applied 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.

1.5 SAMPLE PANEL

The Contractor shall submit: 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.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150, White portland cement, Type I.

2.2 COLORED STUCCO FINISH COAT

Colored 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. Color shall be selected by the Contracting Officer from the color board provided by the contractor.

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, except that cornerite and striplath shall be formed from steel sheets with manufacturer's standard galvanized coating. Welded wire corner reinforcements shall be zinc coated, galvanized 1.4 mm steel wire conforming to ASTM A 185/A 185M. 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 STEEL FRAMING

Steel framing shall be as shown and shall be manufacturers standard products with shop applied protective coating.

2.7 METAL LATH

Metal lath shall conform to ASTM C 847, types and weights in accordance with the various spacing shown in ASTM C 841. Lath for vertical application on steel and wood framing supports shall be expanded metal or welded or woven wire and shall have paper backing with a minimum vapor permeance of 287.2 ng per Pa per second per square meter. 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.

2.8 WATER

Water shall be clean, fresh, potable, and free from amounts of oils, acids, alkalis and organic matter that would be injurious to the stucco.

PART 3 EXECUTION

3.1 FRAMING

Framing shall be installed as indicated.

3.2 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.

3.3 LATH

Lath shall be installed 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. When paper-backed lath is used, the paper shall be split from the lath at all lap areas to provide a paper to paper and lath to lath lap. Horizontal joints shall be shiplapped. Lath shall be interrupted at all control joints.

3.3.1 Steel and Wood Supports

Metal lath without integral backing over vertical open or solid wood and steel backing frame construction shall be applied only after a backing of shiplapped waterproofed building paper or other approved material has been applied to the area to receive the stucco. Lath shall be secured to the wood frames with nails or staples spaced not over 150 mm on centers along each support; and where sheets of lath are lapped, fasteners shall be driven so as to hold both lapped edges securely in place. Lath shall be secured to steel frames in accordance with ASTM C 841 or ASTM C 1063, as applicable.

3.3.2 On Concrete and Masonry

Lath shall be fastened every 200 mm vertically and every 400 mm horizontally. Where wood supports adjoin masonry or concrete in the same direction, casing bead, control joints, or reinforcement shall be provided as indicated.

3.3.3 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.

3.3.4 Special Shapes, Profiles, and Contours

Special shapes, profiles, and contours shall be formed with wood, metal or aluminum furring and reinforcing.

3.4 FURRING

Furring shall be installed to true lines and surfaces and shall be rigidly supported and secured in place.

3.5 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.

3.6 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.

3.7 STUCCO APPLICATION

Stucco shall be applied in two 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:

3.7.1 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.

Stucco showing over sanding, cracks, blisters, pits, checks, discoloration or other defects is not acceptable. Defective plaster work shall be removed and replaced with new plaster at the expense of the Contractor. Patching of defective work will be permitted only when approved by the Contracting Officer. Patching shall match existing work in teture and color. All exterior color finish shall be intergral with the stucco finish.

3.7.2 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 7 days.

3.7.3 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.

3.7.4 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.

3.8 CURING AND PROTECTION

Fog curing shall be accomplished by applying a fine mist of water to the stucco. Care shall be exercised during fog curing to avoid erosion damage to the stucco surfaces. A solid stream of water shall not be used. Frequency of fogging shall be not less than three times daily. When directed the Contractor shall protect the stucco from the direct rays of the sun during severe drying conditions using canvas, cloth or other approved sheet material.

3.9 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 30 00

CERAMIC TILE
01/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1	(2005) Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2006; E 2006) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1026	(2002) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1999; R 2004) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(2006) 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 1178/C 1178M	(2006) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 241	(1990; R 2005) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic

ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 373	(1988; R 2006) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	(2002) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(2004) Breaking Strength of Ceramic Tile
ASTM C 847	(2006) Standard Specification for Metal Lath
ASTM D 2103	(2005) Standard Specification for Polyethylene Film and Sheeting
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4068	(2001) Chlorinated Polyethylene Sheeting for Concealed Water-Containment Membrane
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 446	(1985; R 2004e1) Grab Bars and Accessories Installed in the Bathing Area

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)

Bay Area AQMD Rule 8-51	(1992; R 2001) Adhesive and Sealant Products

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(2003) Dimension Stone Design Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99	(2005; Errata 2005) Health Care Facilities

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

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

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(2003; R 2005) Handbook for Ceramic Tile Installation

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

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

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

Detail Drawings

Drawings showing ceramic tile pattern elevations, floor plans.

SD-03 Product Data

Tile
Setting-Bed
Mortar, Grout, and Adhesive

Manufacturer's catalog data and preprinted installation and cleaning instructions.

SD-04 Samples

Tile
Accessories
Marble Thresholds
Grout

Samples of sufficient size to show color range, pattern, type and joints.

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. Furnish a master grade certificate for tile.

1.3 DELIVERY AND STORAGE

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 stored under cover in accordance with manufacturer's printed instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

a. Close space in which tile is being set to traffic and other work. Keep closed until tile is firmly set. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.

b. 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.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

1.7 DETAIL DRAWINGS

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.

PART 2 PRODUCTS

2.1 TILE

Conform to ANSI A137.1 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 0.60 wet and dry in accordance with ASTM C 1028. Identify floor tile as Class IV Plus-Extra 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.

2.1.1 Mosaic Tile

Provide ceramic mosaic tile and trim shall be unglazed natural clay with cushion edges porcelain unpolished with sharply formed face. Provide tile size 25 by 25 mm <ENG> 1 by 2 inch</ENG> (1 by 2 inch) or a mixture of standard sizes in a stock pattern. Color to be selected by the Contract Officer from the manufacturers' standard list submitted by the contractor.

2.1.2 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free matte finish. Provide tile 150 by 150 mm. Color shall be as selected by Contracting Officer from manufacturers standard listing as submitted by the contractor.

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33 for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150 for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Conform to ASTM C 847 for flat expanded type metal lath, and weighing a minimum 1.4 kg/square meter.

2.2.6 Reinforcing Wire Fabric

Conform to ASTM A 185/A 185M for wire fabric. Provide 50 by 50 mm mesh, or 38 by 50 mm mesh, 16/13 wire.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Conform to the following for mortar, grout, adhesive, and sealant:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A108.1.

2.4.2 Latex-Portland Cement Mortar

ANSI A108.1.

2.4.3 Ceramic Tile Grout

ANSI A108.1; petroleum-free and plastic-free commercial portland cement grout.

2.4.4 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified.

2.4.5 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with ANSI A108.1. Furnish 6.35 mm thick cementitious backer units.

2.5 MARBLE THRESHOLDS

Provide marble thresholds of size required by drawings or conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble with white, pink or gray in color as approved by the Contracting Officer. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C 241.

2.6 MEMBRANE MATERIALS

Conform to ASTM D 226, Type 1 for 33 kg waterproofing membrane, asphalt-saturated building felt. Conform to ASTM D 4068 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 ANSI A108.1 for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	3 mm in 2.4 meter	3.0 mm in 3 meter
Organic Adhesives	3 mm in 2.4 meter	1.5 mm in 1 meter
Latex Portland Cement Mortar	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.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 0.102 mm polyethylene membrane, metal lath, and scratch coat. Conform to ANSI A108.1 for workable mortar bed, materials, and installation of tile. Conform to ANSI A108.1 for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Dry-set or Latex-Portland Cement to install tile in accordance with ANSI A108.1. Use Latex Portland Cement when installing porcelain ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbk method F121. Install shower receptors in accordance with TCA Hdbk method B414.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to ANSI A108.1 for workable mortar bed materials and installation. Conform to ANSI A108.1 for cured mortar bed materials and installation. Provide minimum 6.35 mm to maximum 9.53 mm.

3.4.2 Dry-Set and Latex-Portland Cement

Use dry-set or Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.1. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with ANSI A108.1.

3.4.4 Waterproofing

Install as shown and as specified in this Section, Section 22 00 00 PLUMBING, GENERAL PURPOSE and Section 07 13 53 ELASTOMETRIC SHEET WATERPROOFING.

3.4.5 Concrete Fill

Provide a 24.1 MPa concrete fill mix to dry as consistency as practicable. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 50 mm. Tie laps together with 1.3 mm

wire every 250 mm along the finished edges and every 150 mm along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum 50 mm, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCA Hdbk method.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Install thresholds for interior doors, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 6 mm in width and grouted full.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 7.2 to 10.8 m each way in large interior floor areas and 3.6 to 4.8 m each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

-- End of Section --

SECTION 09 66 16

TERRAZZO TILE
05/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.10	(2005) Installation of Grout in Tilework
ANSI A118.4	(2005) Latex - Portland Cement Mortar
ANSI A118.6	(2005) Standard Cement Grouts
ANSI A118.8	(2005) Polymer Modified Cement Grouts

ASTM INTERNATIONAL (ASTM)

ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 1028	(2007) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 140	(2008a) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 293	(2008) Standard Test Method for Flexural Strength of Concrete
ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM D 56	(2005) Flash Point by Tag Closed Cup Tester
ASTM E 648	(2009a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 84	(2009a) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL TERRAZZO & MOSAIC ASSOCIATION (NTMA)

NTMA Info Guide (2000) Terrazzo Information Guide

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk (2007) Handbook for Ceramic Tile Installation

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

Terrazzo Tile; G

Drawings indicating pattern, size, style, and color of tiles.

SD-03 Product Data

Installation

The manufacturer's printed installation instructions for the conditions indicated.

SD-04 Samples

Terrazzo Tile

Two 150 by 150 mm minimum samples of each color and pattern of terrazzo tile to be used.

SD-07 Certificates

Terrazzo Tile
Adhesive

Certificates indicating that the materials conform to the specified requirements and flooring manufacturer's approval of adhesive, grout and cleaners.

SD-10 Operation and Maintenance Data

Manufacturer's Maintenance Instructions

Six copies of the manufacturer's maintenance literature.

1.3 QUALITY ASSURANCE

Installer shall possess, to the satisfaction of the Contracting Officer, the technical qualifications, experience, trained personnel, and facilities to properly install the specified items.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the jobsite in the manufacturer's original unopened containers marked with the manufacturer's brand name, color, and pattern. Store materials delivered and placed in indoor storage protected from damage, weather, humidity and temperature variation, dirt and dust, or other contaminants. Temperature of storage area shall not be lower than 10 degrees C or higher than 32 degrees C.

1.5 SITE CONDITIONS

Do not install tiles until other work that could cause damage to the finished work has been completed. A temperature of not less than 21 degrees C shall be maintained in areas where tile is to be installed for a period of not less than 48 hours before, during and after laying of tiles. Tiles shall be brought into installation areas and allowed to condition at not less than 21 degrees C for a period of 48 hours prior to installation. After installation of tiles, a minimum temperature of 13 degrees C shall be maintained.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of a manufacturer regularly engaged in the manufacture of the material and that essentially duplicate products that have been in satisfactory use at least 2 years prior to bid opening.

2.2 TERRAZZO TILE

Terrazzo tile shall be of the indicated or as directed colors as per manufacturer's or NTMA color plates and shall consist of marble or granite chips embedded in a portland cement matrix. Tiles shall be 50 mm thick and nominal 250 by 250 mm. Tiles shall have a polished finish with uniform color distribution of chips. Marble chips shall be graded to 6 mm maximum size. Granite chips shall be manufacturer's standard gradation. Tile shall have the following properties:

TERRAZZO TILE PROPERTIES

PROPERTY	TEST METHOD	VALUE
Compressive Strength	ASTM C 140	62 MPa minimum
Flexural Strength	ASTM C 293	6.5 MPa minimum
Water Absorption	ASTM C 140	4.5 percent maximum
Abrasive Wear	ASTM C 501	Index 28
Coefficient of Friction	ASTM C 1028	0.6 dry, 0.5 wet

Flame Spread	ASTM E 84	Class A
Critical Radiant Flux	ASTM E 648	Class I

Sizing Tolerances:
1. All units to conform to shop drawings with a 1/16" tolerance in dimension.

Precast Surfaces and Edges:
1. All exposed edges to be ground and polished with a minimum of 1/16" bevel.
2. All finished surfaces to be ground and polished, free of holes and to have overall uniformity in matrix and aggregate.
3. All precast terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.

2.3 MATERIALS

2.3.1 Portland Cement

ASTM C-150, White.

2.3.2 Aggregates

ASTM C-33, ASTM C-131

2.3.3 Coloring

Pigments used shall be inorganic, resistant to alkalinity, and used per manufacturer's recommendations

2.3.4 Bond Coat Thinset Mortar

Exceed requirements of ANSI A118.4-2005 Latex-Portland Cement Mortar. Use Medium-Bed, Latex-Portland Cement Mortar for tiles larger than 12” x 12”.

2.3.5 Grouting Materials

1. Heat Resistant Grout type: Polymer Modified Sand-Portland Cement Grout – Comply with ANSI A118.7 Polymer Modified Cement Grouts

   a. Liquid Latex Admixture: Liquid Latex added as a replacement for part or all of the mixing water in dry grout mix as specified or recommended by latex manufacturer

   b. Factory prepared cementitious grout mixture including a redispersible, latex/polymer powder to which only water is added at the job site

2. Heat Resistant Grout type: Standard Sand-Portland Cement grout – Exceed ANSI A118.6-2005 Standard Cement Grouts

2.3.6 Reinforcement and Hardware

1. To conform with NTMA and Manufacturer's design.
2. Reinforce precast with deformed rods or wire mesh or both as recommended by precast terrazzo manufacturer.

2.3.7 Cleaner

Liquid neutral chemical cleaner, with pH factor between 7 and 8, of formulation recommended by manufacture for type of precast terrazzo used and complying with NTMA requirements.

2.3.8 Sealer

Colorless, slip and stain-resistant penetrating sealer with pH factor between 7 and 8, that does not affect color or physical properties of precast terrazzo surface. High flash point (ASTM D56): 100 degrees C, Minimum, flame spread: Class A over noncombustable surfaces.

2.4 MIXES

2.4.1 Aggregate

Natural, sound, crushed marble chips or granite chips without excessive flats or flakes, complying with NTMA requirements.

2.4.2 Matrix Pigments

Pure mineral or synthetic pigments, resistant to alkalis and non-fading.

2.4.3 Monolithic Wet Cast

Terrazzo tile shall have 70 percent coverage of the precast terrazzo face with marble or granite aggregate.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify (in the field), dimensions, defects in existing work and deviations beyond allowable tollerances for substrate and advise the Contracting Officer of any discrepancy before performing the work.

3.2 GENERAL

Except as required for installation of new tile, nothing shall be kept on new tile for at least 24 hours after installation.

3.3 SUBSTRATE PREPARATION

Fill holes and cracks with mortar. Substrate shall be plumb, level and true with square corners, free of curing compounds, grease, dirt, loose particles and other foreign matter that would prevent adhesion. Projecting irregularities shall be chipped or ground smooth. Depressions shall be filled and uneven surfaces leveled; maximum variation from plane shall be 3 mm in 3m. Base shall then be rinsed and allowed to dry prior to applying setting mortar.

3.4 INSTALLATION

3.4.1 Tile Laying

Install tile in accordance with TCA Handbook, ANSI A108.3 and the manufacturer's approved installation instructions, except as specified herein. Tile shall be layed as indicated or symmetrical about center lines of vertical surfaces. Joints shall be a minimum of 3 mm to 4.5 mm, and in alignment. Tile shall be cut to fit snugly at pipes and other vertical surfaces. Joints at pipes shall be sealed with adhesive. Entire surface of finished tile countertop and vertical surfaces shall be smooth, straight, and free from mortar, buckles, waves, or projecting tile edges upon completion. Mortar on finished tile is cause for rejection by the Contracting Officer. Damaged or rejected tiles shall be removed and replaced.

3.4.2 Precast Terrazzo Finishing Guidelines

Grouting: Comply with ANSI A108.10-2005 Installation of Grout in Tilework.

3.4.3 Finishing

Apply grout release prior to grouting with cementitious grout. After the grout has set, remove the grout release, clean the floor thoroughly with a neutral ph cleaner and apply the final seal with a product compatible with cement terrazzo and following the sealer manufacturer’s guidelines.

3.5 MOISTURE TEST

After concrete/CMU/firebrick surfaces have been cleaned, small patches of setting mortar to be used shall be spread in several locations on top of encasement and vertical surfaces to receive tile and allowed to dry overnight. If the setting mortar can be peeled easily from the surfaces, the surface is not sufficiently dry. The steps shall be repeated until the setting mortar adheres properly. Tiles shall not be applied until setting mortar adheres tightly to the substrate.

3.6 CLEANING

Upon completion of the installation and after setting mortar has cured, tile surface shall be thoroughly cleaned in accordance with the manufacturer's recommendations.

3.7 PROTECTION

The terrazzo tile work shall be covered and protected from damage until completion of the work of all other trades. Defects which develop, such as loose, broken, or curled tiles, shall be removed and replaced. Submit Manufacturer's Maintenance Instructions.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
10/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	(2005) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	(1996; R 2002) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 2092	(2001e1) Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 235	(2002) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 2824	(2006) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1992; R 2003) Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss

ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 1	(2004) Aluminum Paint
MPI 10	(2004) Exterior Latex, Flat, MPI Gloss Level 1
MPI 101	(2004) Epoxy Anti-Corrosive Metal Primer
MPI 107	(2004) Rust Inhibitive Primer (Water-Based)
MPI 108	(2004) High Build Epoxy Coating, Low Gloss
MPI 11	(2004) Exterior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 113	(2004) Exterior Pigmented Elastomeric Coating (Water Based)
MPI 116	(2004) Epoxy Block Filler
MPI 119	(2004) Exterior Latex, Gloss
MPI 13	(2004) Exterior Solvent-Based Semi-Transparent Stain
MPI 134	(2004) Galvanized Primer (Waterbased)
MPI 138	(2004) Interior High Performance Latex, MPI Gloss Level 2
MPI 139	(2004) Interior High Performance Latex, MPI Gloss Level 3
MPI 140	(2004) Interior High Performance Latex, MPI Gloss Level 4
MPI 141	(2004) Interior High Performance Latex MPI Gloss Level 5
MPI 144	(2004) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 2
MPI 145	(2004) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 146	(2004) Institutional Low Odor/VOC Interior Latex, MPI Gloss Level 4

MPI 147	(2004) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 151	(2006) Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	(2006) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 154	(2006) Interior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 16	(2004) Exterior Latex-Based Solid Hide Stain
MPI 161	(2006) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 163	(2006) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 164	(2006) Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 19	(2004) Inorganic Zinc Rich Primer
MPI 2	(2004) Aluminum Heat Resistant Enamel (up to 427 C and 800 F
MPI 21	(2004) Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6
MPI 22	(2004) Aluminum Paint, High Heat (up to 590 degrees C and 1100 degrees F.
MPI 23	(2004) Surface Tolerant Metal Primer
MPI 26	(2004) Cementitious Galvanized Metal Primer
MPI 27	(2004) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	(2004) Polyurethane, Moisture Cured, Clear Gloss
MPI 39	(2004) Interior Latex-Based Wood Primer
MPI 4	(2004) Interior/Exterior Latex Block Filler
MPI 42	(2004) Latex Stucco and Masonry Textured Coating
MPI 44	(2004) Interior Latex, MPI Gloss Level 2
MPI 45	(2004) Interior Alkyd Primer Sealer
MPI 46	(2004) Interior Enamel Undercoat

MPI 47	(2004) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	(2004) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(2004) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 5	(2004) Exterior Alkyd Wood Primer
MPI 50	(2004) Interior Latex Primer Sealer
MPI 51	(2004) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(2004) Interior Latex, MPI Gloss Level 3
MPI 54	(2004) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 56	(2004) Interior Oil Modified Urethane Clear Gloss
MPI 57	(2004) Interior Oil Modified Urethane Clear Satin
MPI 59	(2004) Interior/Exterior Floor Enamel, Low Gloss
MPI 6	(2004) Exterior Latex Wood Primer
MPI 60	(2004) Interior/Exterior Latex Floor Paint, Low Gloss
MPI 68	(2004) Interior/Exterior Latex Floor Enamel, Gloss
MPI 7	(2004) Exterior Oil Wood Primer
MPI 71	(2004) Polyurethane, Moisture Cured, Clear, Flat
MPI 72	(2004) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(2004) Epoxy Gloss
MPI 79	(2004) Alkyd Anti-Corrosive Metal Primer
MPI 8	(2004) Exterior Alkyd, Flat, MPI Gloss Level I
MPI 9	(2004) Exterior Alkyd, Gloss, MPI Gloss Level 6
MPI 90	(2004) Interior Wood Stain, Semi-Transparent
MPI 94	(2004) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 95	(2004) 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 Guide 6	(2004) Guide for Containing Debris Generated During Paint Removal Operations
SSPC Guide 7	(2004; E 2004) Guide for the Disposal of Lead-Contaminated Surface Preparation Debris
SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC Paint 18	(1982; E 2004) Paint Specification No. 18 Chlorinated Rubber Intermediate Coat Paint
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10	(2000; E 2004) Near-White Blast Cleaning
SSPC SP 12	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2004) Hand Tool Cleaning
SSPC SP 3	(2004e1) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning
SSPC SP 7	(2000; E 2004) Brush-Off Blast Cleaning
SSPC VIS 1	(2002) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Visual Standard for Power-and Hand-Tool Cleaned Steel
SSPC VIS 4	(1998; E 2000) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-680	(Rev B) Degreasing Solvent
MIL-STD-101	(Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K; Change 1) Obstruction Marking and Lighting

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
FED-STD-595	(Rev B; Am 1) Colors Used in Government Procurement

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

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

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

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

Indicate VOC content.

Sealant

SD-04 Samples

Color

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

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

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 confrom 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.

1.5 REGULATORY REQUIREMENTS

1.5.1 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.2 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.3 Asbestos Content

Materials shall not contain asbestos.

1.5.4 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.5 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.6 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. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

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 as specified in Appendix A of EM 385-1-1.

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. Isolate area of application from rest of building when applying high-emission paints or coatings.

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 COLOR SELECTION

Colors shall be selected by the Contracting Officer, from manufacturers standard list submitted by the contractor.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 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.

1.10.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the buildings and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 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.

1.10.2 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.

1.10.3 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.

1.10.4 Exterior Painting of Site Work Items

Field coat the following items:

New Surfaces

a. Exterior unpainted exposed steel

b. Exterior previously primed exposed steel

c. Exterior exposed steel damaged during construction

1.10.5 MISCELLANEOUS PAINTING

Lettering Building

Lettering shall be provided as scheduled on the drawings, shall be block type, and shall be black enamel. Samples shall be approved before application.

1.10.6 Definitions and Abbreviations

1.10.6.1 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.

1.10.6.2 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.

1.10.6.3 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, calendering, 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.

1.10.6.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.6.5 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.

1.10.6.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.6.7 EXT

MPI short term designation for an exterior coating system.

1.10.6.8 INT

MPI short term designation for an interior coating system.

1.10.6.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.6.10 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.

1.10.6.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.6.12 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 @ 60 degrees	Units @ 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).

1.10.6.13 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.

1.10.6.14 Paint

See Coating definition.

1.10.6.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.6.16 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, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

e. Previously painted surfaces specified to be repaintedor damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

g. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

i. Edges of chipped paint shall be feather edged and sanded smooth.

j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

k. New, proposed coatings shall be compatible with existing coatings.

3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding or blasting so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

3.2.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.2.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Brush-off blast remaining surface in accordance with SSPC SP 7. 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/SSPC SP 12 WJ-3.

c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10.

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, SSPC SP 6, and SSPC SP 10. 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. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Spot abrasive blast rusted areas as described for steel in SSPC SP 6, and waterjet to SSPC SP 12, WJ3 to remove existing coating.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 0.20 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new 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 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 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New, Existing Uncoated, and Existing Coated Plywood and Wood Surfaces:

a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

b. Removal of Fungus and Mold: Wash existing coated 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.

c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood : Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat before wood becomes dirty, warped, or weathered.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by

manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 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.

3.6.3 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.

3.6.4 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 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 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.

3.7 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.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 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.

3.11 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.

3.12 PAINT TABLES

All DFT's are minimum values. Use only materials having a minimum MPI "Environmentally Friendly" E1 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.12.1 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. Latex
   New; MPI EXT 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 11	MPI 11	MPI 11

   System DFT: 88 microns

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New concrete masonry on uncoated surface:

1. Latex
   New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)

Block Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 11	MPI 11

   System DFT: 275 microns

Topcoat: Coating to match adjacent 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. Alkyd
New; MPI EXT 5.1Q-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 23 MPI 94 MPI 94
System DFT: 131 microns

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

A. Surfaces adjacent to painted surfaces; Mechanical, Electrical, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Waterborne Light Industrial Coating
MPI EXT 5.1C-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 163 MPI 163
System DFT: 125 microns

3.12.2 3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New Concrete, vertical surfaces, not specified otherwise:

1. Institutional Low Odor / Low VOC Latex
New; MPI INT 3.1M-G5 (Semigloss) / Existing; MPI RIN 3.1L-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 147 MPI 147
System DFT: 100 microns

B. New concrete in toilet areas, food-preparation areas, food-serving areas, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas not otherwise specified except floors:

1. Waterborne Light Industrial Coating
New; MPI INT 3.1L-G5(Semigloss) / Existing; MPI RIN 3.1C-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 153 MPI 153 MPI 153
System DFT: 120 microns

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, ssurfaces adjacent to painted surfaces (match surrounding finish), and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex
   MPI INT 5.1R-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 139 MPI 139
   System DFT: 125 microns</ENG>

B. Metal in toilets areas, food-preparation areas, food-serving areas, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. MPI INT 5.1E-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 47 MPI 47
   System DFT: 131 microns</ENG>

C. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surface:

1. Aluminum Paint
   MPI INT 5.1M
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 1 MPI 1
   System DFT: 106 microns

D. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex
   MPI INT 5.4F-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 95 MPI 141 MPI 141
   System DFT: 125 microns</ENG>

E. Hot metal surfaces including smokestacks subject to temperatures up to 205 degrees C (400 degrees F):

1. Heat Resistant Enamel
   MPI INT 5.2A
   Primer: Intermediate: Topcoat:
   MPI 21 Surface preparation and number of coats per manufacturer's instructions.
   System DFT: Per Manufacturer

F. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

1. Inorganic Zinc Rich Coating
   MPI INT 5.2C
   Primer: Intermediate: Topcoat:
   MPI 19 Surface preparation and number of coats per manufacturer's instructions.

System DFT: Per Manufacturer

G. New surfaces made bare cleaning to SSPC SP 10
subject to temperatures up to 593 degrees C (1100 degrees F):

1. High Heat Resistant Coating
MPI INT 5.2D
Primer: Intermediate: Topcoat:
MPI 22 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New uncoated Wood and plywood not otherwise specified:

1. Institutional Low Odor / Low VOC Latex
New; MPI INT 6.3V-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 39 MPI 147 MPI 147

DIVISION 9: INTERIOR PLASTER SURFACES PAINT TABLE

A. New and previously painted Plaster not otherwise specified:

1. Institutional Low Odor / Low VOC Latex
New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 147 MPI 147
System DFT: 100 microns

B. New and previously painted in toilet areas, food-preparation areas, food-serving areas, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.

1. Waterborne Light Industrial Coating
New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 153 MPI 153
System DFT: 100 microns

-- End of Section --

SECTION 10 35 13.13

STOVE WALL THIMBLES
09/09

PART 1 GENERAL

1.1 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

Submit manufacturers' standard cut sheet for Stove Wall Thimbles showing the manufacturer's recommended color and finish selections.

Submit one sample, assembled sections of wall thimble to show corners, intersections, and other details of construction. Provide any graphics in drawing for approval.

PART 2 PRODUCTS

2.1 TYPE OF WALL THIMBLE

2.1.1 Two-Piece Wall Thimble

Two piece heavy duty galvanized steel wall thimble shall serve dual purpose of both a heat shield and fire-stop. Thimble shall easily slide together for installation from both sides of wall and be provided with trim plate. Inner pipe shall be 304 stainless steel. Provide temporary galvanized steel cap for exterior of building to seal building prior to installation of stove.

PART 3 EXECUTION

3.1 DELIVERY OF MATERIALS

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and install wall thimbles at indicated location.

Contractor must remove and dispose excess packing materials.

3.2 EXAMINATION

Comply with manufacture's requirements of wall conditions for location, sizes, and other conditions affecting installation of stove wall thimbles.

3.3 INSTALLATION

Install only in satisfactory conditions. Comply with manufacturer's written printed instructions for through wall thimble assembly. Set wall thimble at indicated height or as recommended by manufacturer for most effective draft. Coordinate construction of precast concrete cap and cradle to provide clearance for wall thimble. Grout annular space between thimble and precast concrete air-tight.

-- End of Section --

SECTION 10 35 23.13

PROPANE STOVE
10/09

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.72/CSA 11.2	(2006) Portable Type Gas Camp Stoves
ANSI Z83.11/CSA 1.8	(2009) Gas Food Service Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2008; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 96	(2007) Ventilation Control and Fire Protection of Commercial Cooking Operations

NSF INTERNATIONAL (NSF)

NSF 2	(2008) Food Equipment

UNDERWRITERS LABORATORIES (UL)

UL 710	(1995; Rev thru Feb 2007) Exhaust Hoods for Commercial Cooking Equipment

1.2 RELATED REQUIREMENTS

Sections 22 00 00 PLUMBING - GENERAL PURPOSE, 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS, 26 20 00 INTERIOR DISTRIBUTION SYSTEM, apply to this section, with additions and modifications specified herein.

1.3 SUBMITTALS

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

SD-03 Product Data

Propane stove

SD-08 Manufacturer's Instructions

Propane stove

Exhaust hood

SD-10 Operation and Maintenance Data

Propane stove, Data Package 2; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 WARRANTY

1.4.1 Propane Stove

Full warranty includes parts and labor for on-site service on unit. Warranty period for components: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PROPANE STOVE

2.1.1 Stove

Standard Features as follows:

Ignition via match lit

Stainless Steel 304

Large triple ring burner and three independent control valves on face of unit to produce a wide heat range and accurate temperature control.

Inner center burner ring for low heat approximately 1-10,000 BTUs, middle burner ring for approximately 1-20,000 BTUs (center and middle burner for medium heat), outer burner ring for approximately 1-30,000 BTUs, total of approximately 60,000 BTUs of evenly distributed, clean burning blue flame with all three burners on for high heat.

Leg extensions for indicated cooking height.

Hose and regulator with quick disconnect fittings.

Stainless Steel rod cooking grid

2.1.2 Materials

Except as modified herein, provide manufacturer's standard materials for propane stove. Provide quantities, physical dimensions, colors, and electrical characteristics as indicated.

2.1.3 Exhaust Hoods Over Cooking Equipment

Section 23 00 00, Paragraph 2.16, NSF 2, factory fabricated, with replaceable grease filters.

2.1.3.1 Hood Construction

Section 23 00 00, Paragraph 2.16, welded joints and seams, ground and polished to match adjacent exterior surfaces. Provide stainless steel duct collars and risers.

2.1.3.2 Filter Housing, Grease Gutter, and Removable Grease Container

Section 23 00 00, Paragraph 2.16.

2.1.3.3 Accessories

Provide UL classified washable grease filters, vaporproof light fixtures, wiring in conduit between light fixtures, fan control, damper controls and fire protection system as per Section 23 00 00, Paragraph 2.16.

2.1.4 Fans - Supply and Exhaust

Section 23 00 00, Paragraph 2.16, type as indicated, UL 710; centrifugal fan with maximum sound pressure level 45 dB. Provide factory fabricated adjustable roof curbs.

2.1.5 Gas Piping

Section 22 00 00, black/galvanized steel.

2.1.6 Propane Tanks

By Others: Tank size not exceeding 100 pounds or 22 water gallons in volume; NFPA 58.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70, ANSI Z21, ANSI Z83, Section 22 00 00 PLUMBING, GENERAL PURPOSE, Section 23 00 00 AIR SUPPLY, DISTRIBUTIOIN, VENTILATION, AND EXHAUST SYSTEMS and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install propane stove in encasement (Section 04 20 00 Masonry) on concrete equipment pad (Section 03 30 00 Cast-in-place-Concrete) in accordance with manufacturers' instructions and as indicated. Field verify actual stove dimentions prior to construction of CMU and tile encasement. Verify placement of stainless steel back splash (Section 05 50 00) between bottom of hood and top of terrazo tile (Section 09 66 16) and placement of steel corner guard (Section 05 50 00) at outside corners, horizontal and vertical edges of encasement.

Terminate steel gas piping in front of propane stove with shut-off valves and quick disconnect nipple. Connect propane stove to stainless piping with stainless steel flexible hose (Gastite or equal) as per NFPA 58 Section 5.8.6 using quick disconnect dielectric fittings.

3.2 FIELD QUALITY CONTROL

Conduct inspection and testing in the presence of the Contracting Officer to certify compliance with specified and manufacturer's performance parameters. Affect repairs and retest until no deficiences exist.

3.2.1 Field Inspection

Before and after installation, inspect propane stove and ancillary work for compliance with specified requirements.

3.2.2 Operation Tests

Upon completion, but before final acceptance, perform operation tests on propane stove and ancillary work as to piping, exhaust and make-up air flow, etc. to determine that components, including controls, safety devices, and attachments, operate properly and in accordance with specified requirements.

-- End of Section --

SECTION 10 44 16

FIRE EXTINGUISHERS
06/06

PART 1 GENERAL

1.1 REFERENCES

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

INTERNATIONAL CODE COUNCIL (ICC)

IFC 1414	(2004) Portable Fire Extinguishers(Where Required)(Construction, Alteration, Demolition)
IFC 906	(2004) Portable Fire Extinguishers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2006) Uniform Fire Code, 2006 Edition
NFPA 10	(2006; Errata 2006) Standard for Portable Fire Extinguishers
NFPA 101	(2006) Life Safety Code, 2006 Edition
NFPA 303	(2006) Fire Protection Standards for Marinas and Boatyards
NFPA 385	(2000) Standard for Tank Vehicles for Flammable and Combustible Liquids
NFPA 409	(2004) Standard on Aircraft Hangers
NFPA 418	(2001) Standard for Heliports
NFPA 505	(2006) Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations
NFPA 99	(2005; Errata 2005) Health Care Facilities

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

29 CFR 1910.106	Flammable and Combustible Liquids
29 CFR 1910.157	(2003) Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 154	(2005) Standards for Carbon Dioxide Fire Extinguishers

UL 2129	(2005) Standards for Halocarbon Clean Agent Fire Extinguishers
UL 299	(2002; R 2005e10) Standards for Dry Chemical Fire Extinguishers
UL 626	(2005e8) Standards for Water Fire Extinguishers
UL 8	(2005e6) Standards for Water Base Agent Fire Extinguishers

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Manufacturer's Data for each type of required Fire Extinguisher with all related details, cabinets, accessories, and recommended operation manuals.

SD-02 Shop Drawings

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory. Submit installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Fire Extinguishers
Accessories
Wall Brackets

SD-03 Product Data

Submit Manufacturer's catalog and warranty data for the following items:

Fire Extinguishers
Accessories
Wall Brackets
Replacement Parts

SD-04 Samples

One Fire Extinguisher of each type to be installed

One full-sized sample of each type of Cabinet to be installed

Three samples of Wall Brackets and Accessories of each type to be used

Approved samples may be used for installation, with proper identification and storage.

SD-07 Certificates

Submit Certificates showing the following:

Certification that Fire Extinguishers comply with local codes and regulations.

Certification that Fire Extinguishers comply with OSHA, NFPA, and UL requirements.

Submit Manufacturer's Warranty with Inspection Tag on each extinguisher.

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 3 years after completion.

1.3 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

PART 2 PRODUCTS

2.1 TYPES

Fire Extinguishers must conform to NFPA 10 Quantity and placement must comply with the applicable sections of IFC 1414, IFC 906, NFPA 1, NFPA 101, 29 CFR 1910.106 and 29 CFR 1910.157.

Provide dry chemical type fire extinguishers compliant with UL 299.

Submit Manufacturer's Data for each type of Fire Extinguisher required, detailing all related wall mounting and accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Extinguisher shell must be corrosion-resistant steel.

2.3 SIZE

Extinguishers must be 4.5 kilogram.

2.4 ACCESSORIES

Forged brass valve

Fusible plug

Safety release

Antifreeze

Pressure gage

2.5 WALL BRACKETS

Provide wall-hook fire extinguisher wall brackets.

Wall bracket and Accessories must be as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Comply with the manufacturer's recommendations for all installations.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Provide Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

SECTION 10 75 00.00 48

FLAGPOLES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

Shop Drawings.; FIO
Indicate detailed dimensions, base attachment details, anchor requirements, and imposed loads.

SD-03 Product Data

Product Data; FIO

Provide data on pole, accessories, and configurations.

Operation Data; FIO

Provide operating data for the controller.

Maintenance Data; FIO

Provide lubrication and periodic maintenance requirement schedules.
Acceptable Manufacturer Products; FIO

Manufacturers products listed in this specification are referenced to establish a standard of quality. When the specific product listed is submitted by the Contractor, that submittal will be considered For Information Only). When an equal to that named in this specification is submitted, it shall be for Government Approval (G). The following manufacturer products are specifically mentioned in this specification:

Flagpole: American Flagpole, FIO
26252 Hillman Highway
Abingdon, VA. 24212-0547
800.368.7171
www.americanflagpole.com

Flagpole: Ewing Flagpoles., Inc.; FIO
2316 Delaware Avenue #283
Buffalo, NY 14216
716.833.3278

Flagpole: Concord Industries, Inc.
4150-A Kellway Circle
P. O. Box 2449
Addison, Texas 75001
800.527.3902
www.flagpoles.com

Flagpole Manufacturer Product submitted as an "or equal"; G

SD-04 Samples

Samples; FIO

Submit two samples 100mm x 100mm in size illustrating pole material, color, and finish.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

PART 2 PRODUCTS

2.1 POLE MATERIALS

Aluminum: ASTM B241, 6063 alloy, T6 temper.

2.2 POLE CONFIGURATION

2.2.1 Ground Mounted

Ground set, tapered shaft, internal halyard with winch.

1. Outside Butt Diameter: 152 mm.
2. Nominal Wall Thickness: 4mm.
3. Nominal Height: 9.14 meters measured from nominal ground elevation.

2.3 COMPONENTS AND ACCESSORIES

Designer to make selection.

2.3.1 Finial Ball

Stainless steel, diameter.

2.3.2 Truck Assembly

Cast aluminum revolving, stainless steel ball bearings, non-fouling.

2.3.3 Flag

Flag shall be provided by others.

2.3.4 Winch

An internal winch operated by a removable handcrank. The winch contains an automatic brake system to permit locking of the flag in any position.

2.3.5 Winch Box

Aluminum, with built-in hinge and lock assembly, attached to pole with tamper proof screws inside box. Provide two keys to operate the lock.

2.3.6 Halyard

Stainless steel aircraft cable with two chrome plated bronze swivel snaphooks, plastic covered counterweight and beaded sling.

2.3.7 Primer

As recommended by the flagpole manufacturer.

2.4 MOUNTING COMPONENTS

Foundation to be sized based on local conditions.

2.4.1 Foundation Tube Sleeve

AASHTO M-36, corrugated 16 gage steel, galvanized, depth as recommended by the flagpole manufacturer.

2.4.2 Pole Base Attachment

Flush aluminum base with base cover.

2.4.3 Wall Support Assembly

Aluminum; round; one piece assembly, back-plate for through bolting, with stainless steel anchor bolts and cover.

2.4.4 Lighting Ground Rod

304.8 mm (12 inches) long copper rod, 19.05 mm (3/4 inch) diameter.

2.4.5 Lightning Ground Cable

Copper No. 6 AWG, soft drawn.

2.5 FINISHES

Selection to be made from manufacturer's standard.

2.5.1 Metal Surfaces in Contact With Concrete: Asphaltic paint.

2.5.2 Aluminum: Anodized clear satin finish.

2.5.3 Finial: Gold anodized finish atop stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

Fill foundation tube sleeve with concrete specified in Section 03 30 00.00 40, CAST-IN-PLACE CONCRETE.

Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.4 ERECTION TOLERANCES

Maximum Variation From Plumb: 25mm.

3.5 ADJUSTING

Adjust operating devices so that halyard and flag function smoothly.
--End of Section--
-- End of Section --

SECTION 10 90 00.00 48

MISCELLANEOUS SPECIALTIES
4/06

PART 1 GENERAL

1.1 REFERENCES

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

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

Clothesline Structure

Drawings showing construction and installation details.

SD-03 Product Data

Product certification and installation recommendation data.

Clothesline Structure

1.3 DELIVERY AND STORAGE

All items shall be delivered to the project site in manufacturer's undamaged containers.

1.4 WARRANTY

Provide manufacturer's standard warranty for the items.

PART 2 PRODUCTS

2.1 CLOTHESLINE ASSEMBLY

Each clothesline assembly shall be approximately 5 m in length with four lines across spaced 410 mm apart and shall have sufficient strength to prevent sagging when all of the lines are loaded with wet laundry. Clotheslines shall be installed 1.6 m above surrounding finished grades.

Materials shall comply with requirements of this specification. Clothesline assemblies shall be either the standard product of a manufacturer regularly engaged in the manufacture of outdoor clotheslines, or shall be fabricated in accordance with this specification.

2.1.1 Supporting Structure

The clothesline supporting structure shall be constructed with galvanized steel pipes, fittings and eyebolts conforming to requirements of Section 05 50 00 unless otherwise approved. Piping, fittings, and eyebolts shall have sufficient strength to comply with requirements of Section 2.1 of this specification.

2.1.2 Clothesline

Clothesline shall consist of rope or vinyl covered steel wire that does not stretch when pulled taut or weighted down.

2.1.3 Concrete

Concrete for the foundations shall conform to requirements of Section 03 30 00.00 40.

PART 3 EXECUTION

3.1 INSTALLATION

Install all items in strict accordance with manufacturer's recommendations and these specifications. Install at the locations indicated on the drawings. Align and plumb all items with adjacent surfaces and set accurately in location.

Clotheslines shall be installed behind each barracks.

Clothesline posts shall be embedded below grade in concrete. The depth and width of concrete embedment shall be that needed to satisfy the clothesline assembly strength requirements outlines in Section 2.1 of this Specification. In no case shall the depth of embedment be less than the frost depth.

Clotheslines shall have a minimum furnished height of 1.6 m.

3.2 PROTECTION AND CLEANING

Protect the work from other trades and remove all protective wrappings when appropriate. Clean all surfaces in accordance with manufacturer's recommendations.

-- End of Section --

SECTION 12 30 00.00 40

CASEWORK
04/07

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2006a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 325	(2006) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2005) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM D 13	(2002) Standard Specification for Spirits of Turpentine
ASTM D 4689	(1999; R 2005) Standard Specification for Adhesive, Casein-Type
ASTM D 4690	(1999; R 2005) Standard Specification for Urea Formaldehyde Resin Adhesives
ASTM F 594	(2002) Standard Specification for Staninless Steel Nuts
ASTM F 836M	(2002) Standard Specification for Style 1 Stainless Steel Metric Nuts

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(2003) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	(2002) Medium Density Fiberboard (MDF) For Interior Applications

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2003; Errata 2003; Errata 2004; Errata 2004; Errata 2005) International Plumbing Code

SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION (SEFA)

SEFA 7	(1996) Recommended Practice for Laboratory and Hospital Service Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-2962	(Rev J) Enamel, Alkyd, Gloss, Low VOC Content
FS FF-B-588	(Rev E) Bolt, Toggle: and Expansion Sleeve, Screw
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS MM-L-736	(1983c) Lumber; Hardwood
FS MM-L-751	(Rev H) Lumber; Softwood
FS TT-C-490	(1990; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS TT-C-520	(Rev B; Am 1) Coating Compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles)
FS TT-E-491	(Rev C) Enamel; Gloss, Synthetic (for Metal and Wood Furniture)
FS TT-F-336	(Rev E) Filler, Wood, Paste
FS TT-V-121	(Rev H) Varnish, Spar, Water-Resisting
FS WW-P-541	(1990e; Am 1) Plumbing Fixtures

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Fabrication drawings shall be submitted for steel and wood cabinets in accordance with the paragraphs entitled, "Wood Cabinet, Steel Cabinet and Counter Top and Back Splash Fabrication," of this section; G.

Installation Drawings shall be submitted for steel and wood cabinets in accordance with the paragraph entitled, "Installation," of this section; G.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Corrosion-Resistant Steel; G
Plywood; G
Hardwood; G
Glass; G
Adhesives; G
Filler Material; G
Turpentine; G
Varnish; G
Fasteners; G
Service Fixtures; G
Accessories and Hardware; G
Softwoods; G

SD-04 Samples

Samples shall include:

Counter Top and Back Splash, one each, 100 millimeter in width, submitted as one unit or as separate items; G.

Accessories and Hardware, one each; G.

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "General," of this section; G.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Corrosion-Resistant Steel; G
Plywood; G
Hardwood; G
Adhesives; G
Filler Material; G
Turpentine; G
Varnish; G
Fasteners; G
Steel Sinks; G
Service Fixtures; G
Accessories and Hardware; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for in accordance with paragraph entitled, "General," of this section.

1.3 DELIVERY, STORAGE, AND HANDLING

Cabinets shall be delivered, stored, and handled in a manner that will prevent damage and disfigurement.

Temporary skids shall be provided under units weighing more than 80 kilograms.

PART 2 PRODUCTS

2.1 GENERAL

Manufacturer's Standard Color Charts shall be submitted for wood and metal cabinets showing the manufacturer's recommended color and finish selections.

Manufacturer's Instructions shall be submitted for wood and metal cabinet systems including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Cabinets shall be the manufacturer's standard sizes of type and design indicated. Both wall and base cabinet assemblies shall consist of individual units joined into continuous sections as indicated. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation.

2.2 MATERIALS

Steel for cabinet construction shall conform to ASTM A 1008/A 1008M.

Corrosion-Resistant Steel shall conform to ASTM A 167, Type 304 Finish 4.

Douglas-fir Plywood shall conform to ICC IPC, exterior type, fully waterproof bond.

Adhesives for application of plastic laminate shall be a thermosetting urea-resin Type II conforming to ASTM D 4690 as recommended by the manufacturer of the laminate. Adhesive for wood members shall conform to ASTM D 4689.

Filler Material shall conform to FS TT-F-336.

Hardwood shall conform to FS MM-L-736, standard hardwood lumber, S2S.

Hardwood plywood shall conform to ICC IPC.

Particle Board shall conform to CPA A208.1, Type 1, Grade M or medium density.

Softwoods shall conform to FS MM-L-751, factory and shop grade.

Turpentine shall conform to ASTM D 13.

Varnish shall conform to FS TT-V-121.

Accessories and Hardware shall conform to the following requirements, as applicable:

Extension drawer slides: BHMA A156.9, Type B85071

Semiconcealed hinges: BHMA A156.9, Type B81201, 1-1/2 inches

Full surface hinges: BHMA A156.9, Type B81131, 1-1/2 inches

Knob pulls: BHMA A156.9, 1-inch diameter, Type B12132

Bar type pulls: BHMA A156.9, 4-inch overall length, Type B12012

Semiconcealed hinges: BHMA A156.9, Type B81201, 40 millimeter

Full surface hinges: BHMA A156.9, Type B81131, 40 millimeter

Knob pulls: BHMA A156.9, 25 millimeter diameter, Type B12132

Bar type pulls: BHMA A156.9, 100 millimeter overall length, Type B12012

Locks, keying, and keys: As directed

Catches: Magnetic, 22 newton pull

Sliding door set:

Impregnated fiberboard track

Nylon glides

Fasteners shall conform to the following:

Screws: ASME B18.6.1, Group, Type and Class as applicable

Anchoring Devices: FS FF-S-325, Group, Type, and Class as applicable

Toggle bolts: FS FF-B-588, Type I, Class A, Style 2

Nuts: ASTM F 594, corrosion-resistant steel

Bolts: ASTM A 325, heavy, hexagon head bolts corrosion-resistant steel

Nuts: ASTM F 836M, corrosion-resistant steel

Bolts: ASTM A 325M, heavy, hexagon head bolts corrosion-resistant steel

2.3 WOOD CABINET FABRICATION

Wall and base cabinets shall be essentially of same construction and same outside appearance. Cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 20 by 40 millimeter kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Top and bottom corners shall be braced with

hardwood blocks that are glued with water-resistant glue and nailed in place. Base cabinets shall be provided with an integral toe space at least 65 millimeter deep and 100 millimeter high. Drawers shall be mounted on metal guides. Shelves shall be removable and adjustable, as indicated.

Minimum thicknesses of materials for frame-front, solid-end cabinet construction shall be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets: 3 millimeter tempered hardboard. Bottoms shall be braced with wood members glued in place.

Cabinet ends: 15 millimeter hardwood-veneer plywood

Doors: 20 millimeter hardwood plywood, doors

Drawer fronts: 20 millimeter hardwood

Drawer bottoms: 4.76 millimeter plywood or tempered hardboard. Drawer bottoms over 380 millimeter wide shall be braced with wood members glued in place.

Drawer sides and backs: 15 millimeter hardwood

Interior partitions or dividers: 15 millimeter fir plywood, Grade A-A

Shelves: Grade A-B plywood, supported on ends and 600 millimeter on centers

Adjustable shelves: 20 millimeter plywood

Base cabinet shelves: 16 millimeter plywood

Wall cabinet shelves: 15 millimeter plywood, glued-up solid wood

Minimum thicknesses of materials for frame-type cabinet construction shall be as follows:

Cabinet ends: 6 millimeter hardwood plywood

Backs, bottoms, partitions, and dividers: 4 millimeter tempered hardboard in a frame

Materials for other components shall be as specified.

2.4 STEEL CABINET FABRICATION

2.4.1 General

Wall and base cabinets shall be of essentially the same construction, fabricated from cold-rolled furniture steel not lighter than 0.85 millimeterexcept that backs of cabinets and backs of doors may be 0.70 millimeter steel. Wall cabinets shall have corner mullions of full-wrap construction consisting of three 90-degree bends, with no raw edges or flanges exposed. Base cabinets shall be equipped with fixed top rails and shall have an subbase forming a recessed toe space 100 millimeter high and not less than 65 millimeter deep. Welds shall be flush and ground smooth on

exposed surfaces. Heads of screws and bolts shall not show in exposed exterior surfaces. Doors and drawer fronts shall be double-wall, panel-type construction, not less than 15 millimeter thick, with a sound-absorbing material cemented between the walls. Doors and drawers shall be equipped with rubber or plastic silencers or bumpers. Drawers shall have removable fronts, shall be mounted on metal guides and shall be equipped with position stops to avoid accidental complete withdrawal. Shelving shall be fixed, adjustable as indicated, and shall be formed on four sides with two additional 90-degree bends on front edge.

2.4.2 Workmanship

End panels, top rails, bottoms and vertical posts shall be aligned at intersections in same plane, without overlap.

Exposed welds shall be ground flush and smooth.

2.4.3 Minimum Thickness of Steel

	U.S. STANDARD GAGE	THICKNESS (MILLIMETER)
Hinge reinforcement, tapping strips, gussets, drawer runners	14	1.9
Cabinet top rail, hanging brackets, frame, and base	16	1.6
Outer door pan and slide support, cross rails, cabinet fronts, scribe strips, and fillers	18	1.3
Shelves, other steel items	20	1.0

2.4.4 Cabinets

Cabinets shall have sheet steel fronts, backs, sides, tops, and bottoms.

Sides shall be formed with rabbeted stiles 28 millimeter wide, closed by welded channel containing embossed louvers spaced 40 millimeter on center, for adjustable shelves.

Cabinets shall have a steel channel-shaped top rail, 1.3 millimeter steel cross rails, and Z-shaped rear rail to engage 1.6 millimeter steel hanging bracket.

At base cabinets, 40 millimeter long leveling screws shall be provided for adjusting to floor variations and shall be accessible through plugged openings in bottom; 1.9 millimeter gussets shall be installed to support the screws.

At base cabinets, removable backs, knee space panels, or access doors shall be provided where piping occurs.

2.4.5 Doors

Doors shall be double-pan construction with 16 millimeter thick telescoped inner pan into outer pan with exposed vertical edge formed into channel shape having returned lip over inner pan and offset to receive lip.

Panels shall be coated with 3 millimeter thick asphaltic sound deadener.

Reinforcement shall be fastened for hardware attachment to inner pan and shall be concealed.

Hinged doors shall be fitted with pairs of hinges, knob pulls, locks, and bumpers.

Inside edge of cutout in front panel of glass door shall be beveled.

Glass shall be set in continuous rubber gasket between panels.

Sliding doors shall be equipped with tracks, guides, bumpers, and bar pulls.

Doors for the exposed fronts of metal cabinets shall be:

Hardwood plywood

Sound-deadened metal

Doors shall be not less than 15 millimeter thick.

2.4.6 Drawers

Drawer fronts shall be double-pan construction with 16 millimeter thick telescoped inner pan into outer pan with exposed vertical edge formed into channel shape having return lip over inner pan and offset to receive lip. Drawer bodies shall be welded to front through flanges on sides and bottom, and to back through flanges at rear.

Flanges shall be extended outward or downward, top of side, and backrolled.

Corners shall be coved to 15 millimeter radius.

Drawer accessories shall consist of slides, bar pulls, and lock and stop devices.

2.4.7 Shelves

Shelves shall be fabricated from corrosion-resistant steel sheet with front and rear edges flanged down 20 millimeter and hemmed back at 30 degrees to underside of shelf.

Shelves shall be supported with 1.6 millimeter shelf clips inserted in slots in front stile and in form channel in back.

Flanges shall be notched at sides to match and engage with embossments on side panels.

2.4.8 Dustcover Tops

Front face height shall be 25 millimeter.

Dustcover tops shall be sloped upward 30 degrees from front to back of cabinet.

Dustcover tops shall be equipped for attaching from inside of cabinet.

2.4.9 Finish

Steel cabinets shall be primed and factory-finished with two coats of synthetic enamel, baking quality, conforming to FS A-A-2962, Class B. Colors shall be as selected.

2.5 COUNTER TOP AND BACK SPLASH FABRICATION

Counter tops and back splash shall be stainless steel on plywood.

Plywood shall be a water-resistant type, Grade B-D Douglas fir plywood, with a minimum thickness of 20 millimeter. Back splash shall be the height indicated.

Steel shall be not lighter than 0.85 millimeter corrosion-resistant stainless steel for backed construction and not lighter than 1.3 millimeter corrosion-resistant stainless steel for integral construction. Steel tops shall be reinforced on edges and around sink-rim opening. Counters shall be of one-piece construction; where corrosion-resistant sink bowls are provided, joints shall be welded and polished smooth. Joints between sink, counter top, and back splash shall be made watertight. Back splash shall be of the same material as counter top and shall be formed with square edges. Height shall be as indicated.

Edging and trim:

For corrosion-resistant stainless steel counter tops and back splash, the edging and trim shall be formed as an integral part of the top.

Sink rims shall be standard products of a manufacturer regularly producing this type of equipment, and shall be fabricated from corrosion-resistant steel of the size necessary to receive the sinks.

Chopping block shall be of the size and in the location indicated. Chopping block shall be:

Portable type, of solid edge-grain clear maple, minimum 20 millimeter thick, sized to fit on a suitable rack for storage

Stationery type or built-up, edge-grain clear maple, minimum 40 millimeter thick, installed in a counter top

Chopping blocks shall not be mounted in the toprail of base cabinets.

2.6 SURFACING

2.6.1 Corrosion-Resistant Stainless Steel Surfacing

Counters and work surfaces shall be formed of 1.6 millimeter sheets with exposed edges returned.

Hat-shaped channels, 1.6 millimeter, shall be used for reinforcement, spaced 760 millimeter on center.

Surfaces shall be equipped with wood strips under edges for fastening to cabinets.

Internal corners shall be coved to 15 millimeter radius.

Underside shall be coated with 3 millimeter thick sound deadener.

Joints shall be electrically welded, ground smooth, and polished to match adjacent finish.

2.7 MISCELLANEOUS CABINETS

2.7.1 Combination Sink-and-Base Cabinet

A combination sink-and-base cabinet unit may be furnished in lieu of the base cabinet and inset sink indicated provided the combination unit affords facilities and space equal to those indicated and provided the combination unit matches the adjacent units in materials and construction. Sink, with matching drainboards, shall be corrosion-resistant stainless steel and shall be equipped with a chromium-plated swinging-spout faucet, chromium-plated water-control valves, and chromium-plated cup strainer. Joints between sink and drainboard and between drainboard and counter top shall be made watertight.

2.7.2 Special Purpose Cabinets

Special-purpose cabinets, such as cabinets for eye-level oven units, countertop range units, and built-in refrigerators and desks, shall be furnished as indicated and shall be of same materials and construction as adjacent cabinets. Space shall be provided adjacent to sink for a dishwasher, as indicated.

2.8 ACCESSORIES AND HARDWARE

Accessories such as utility shelves and racks for extracts, condiments, and towels; bins for sugar and flour; breadboxes; and trays for cutlery and flatware shall be furnished as indicated.

Hardware shall be corrosion resistant. Exposed hardware shall have a chromium-plated finish or a corrosion-resistant finish as approved. Semiconcealed hinges on cabinets where paint finish is required shall be painted to match the cabinets. Doors shall be equipped with bullet-type catches. Door and drawer pulls shall be as indicated.

PART 3 EXECUTION

3.1 FIELD FINISHING OF WOOD CABINETS

For painted finish, a prime coat and two coats of synthetic enamel of air-drying quality, conforming to FS A-A-2962, Class A, shall be applied. Colors shall be as selected.

For natural finish, the applicable procedure for the type of wood shall be followed:

For open-grain woods: One coat of paste wood filler shall be applied, and excess filler shall be removed. One coat of pale varnish thinned with turpentine shall then be applied, followed by one coat of pale varnish and then by one coat of satin-finish varnish, plus an additional coat of satin-finish varnish on cabinet doors and drawer fronts. Surfaces shall be lightly sanded between coats.

For close-grain woods: One coat of pale varnish thinned with turpentine shall be applied, followed by one coat of pale varnish and then by one coat of satin-finish varnish, plus an additional coat of satin-finish varnish on cabinet doors and drawer fronts. Surfaces shall be lightly sanded between coats.

At the Contractor's option, wood cabinets with a factory finish standard set by the cabinet manufacturer may be provided.

3.2 INSTALLATION

Casework shall be installed plumb with countertops level to within 1 millimeter in 3000 millimeter.

Base cabinets shall be leveled by adjusting leveling screws.

Scribe strips shall be scribed and fitted to irregularities of adjacent surfaces. Gap opening shall not exceed 0.63 millimeter.

Cases shall be secured permanently to floor and wall construction using 6 millimeter diameter masonry anchors, spaced 760 millimeter maximum on center, minimum of two for each case.

Wall cases shall be supported on continuous 1.3 millimeter galvanized steel hanging brackets.

Wall cases shall be secured in position with screws to blocking.

Adjoining cases shall be bolted together. Width of joints shall not exceed 0.79 millimeter.

Closer strips, filler strips, and finish moldings shall be provided as required.

Doors shall be aligned, hardware adjusted, and surfaces cleaned and waxed.

Installation Drawings shall be submitted for steel and wood cabinets. Drawings shall include location of cabinets, details of cabinets related and

dimensional positions, and locations for roughing in plumbing, including sinks, faucets, strainers and cocks.

3.3 CLEANING

On completion of cabinet installation, marred or abraded finished surfaces shall be touched up.

Crating and packing materials shall be removed from premises.

Surfaces shall be wiped down to remove fingerprints and markings and shall be left in clean condition.

3.4 INSPECTION

Casework grounds and supports shall be examined for adequate anchorage, foreign material, moisture, and unevenness that could prevent quality casework installation.

Ensure that electrical and plumbing rough-ins for casework are complete.

Do not proceed with installation until defects are corrected.

-- End of Section --

SECTION 12 55 00

DETENTION FURNITURE AND ACCESSORIES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel

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

Mirrors; G

Pass window; G

Safety clothes hooks; G

Key cabinet; G

Bunks; G

Seats; G

Include details of frames, conditions of openings, details of construction, location and installation requirements of hardware and reinforcements, and details of joints and connections showing sizes and locations of welds. Indicate fabrication, erection, anchorage, and accessories.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver furniture and accessories in packaging to provide protection during transit and job storage. Leave in unopened original containers, clearly labeled for location of installation.

PART 2 PRODUCTS

2.1 MATERIAL

Steel plate, ASTM A 36/A 36M.

2.2 MIRRORS

a. Mirror shall be 0.8 mm thick sheet steel, highly polished and bright chrome plated.

b. Frame shall be 16 gage cold-finished steel with 8 mm inner and outer flanges.

c. Mirror size shall be approximately 200 by 250 mm with overall size of approximately 250 by 290 mm.

d. Provide one framed mirror over lavatory in each prisoner housing area.

2.3 PASS WINDOW

Window shall consist of a pass drawer below a speaker panel with a security glazing panel above. The glazing panel shall be the same type as the adjacent glazing. The pass drawer shall be 100 mm deep, 400 mm wide, and 300 mm long and roll horizontally with an interlocking hinged cover on both sides. The speaker panel shall be constructed of perforated metal (T-304 stainless steel), 16 gage, 5 mm perforated holes, rectangular in shape the full width of the panel, with 14 gage baffles to prevent direct line of sight from one side to the other. This unit shall be integrated into the hollow metal of the adjacent unit.

2.4 BUNKS

Cell bunks shall consist of a bed frame measuring 1980 mm long by 750 mm wide with front and back composed of an angle measuring 50 by 50 by 6 mm and ends of frame formed by wall brackets made of 20 gage steel sheet flanged 50 mm at wall and lower edge. Back angle shall be kept 50 mm from wall. Bottom of bunk shall be made of not lighter than 16 gage steel sheet with round or square holes with rounded corners, spaced as standard with the manufacturer. Join the entire assembly by electrical welding; welds shall be of deep penetration, continuous, and ground smooth. Prime bunks with one shop coat of primer. Bunks shall be wall and floor mounted.

2.5 SEATS

Seats shall be designed for wall mounting to masonry walls with 6 mm diameter by 500 mm long spanner head screws in lead anchor. Seat size shall be approximately 300 mm wide by 450 mm deep; made of 5 mm steel with 40 mm flange for wall mounting. Seat shall have one shop coat of primer paint. Provide in locations and quantity indicated.

2.6 KEY CABINET

Provide for detention lock keys with a capacity of 1.75 times the number of door locks and a complete dual-tag system. Cabinet shall have concealed-type hinges and rounded sides and panels with individual hook and label pockets

formed as an integral part of the panel. Provide tags of two types, one set for permanent holding of at least four keys. Provide indexing to record information concerning locks and keys, alphabetically; hook, numerically; and master key. Furnish permanent loan registry to protect identity of key borrowers. Furnish receipt tabs to protect identity of key borrowers and supply receipt tabs for temporary loan. Provide one cabinet in the main control center, and one duplicate cabinet in the Station Security Office and one duplicate cabinet in the Commanding Officer Office.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Mirrors

Mount 1600 mm up to center line, and anchor with 6 mm flat head spanner screw in lead masonry anchors.

3.2 ADJUSTMENT

Adjust items and components of items specified in this section to ensure proper operation.

-- End of Section --

SECTION 13 34 19

PREENGINEERED METAL BUILDINGS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary
AISC FCD	(1995a) Quality Certification Program Description
AISC S329	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 500	(2003a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 529/A 529M	(2005) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 572/A 572M	(2006) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2005) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 755/A 755M	(2006) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 221M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C 1363	(2005) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C 518	(2004) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 991	(2003) Flexible Glass Fiber Insulation for Metal Buildings
ASTM D 1308	(2002e1) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2224	(1978; R 1983) Standard Test Method for Mean Molecular Weight of Mineral Insulating Oils by the Cryoscopic Method
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss

ASTM D 5894	(1996) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2001) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(2002e1) Evaluating Degree of Blistering of Paints
ASTM D 828	(1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 968	(2005) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	(2004) EnviroTop Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

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

SMACNA Arch. Manual	(2003, 6th Ed) Architectural Sheet Metal Manual

STEEL DECK INSTITUTE (SDI)

SDI DDMO3	(3rd Edition) Diaphragm Design Manual

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003) Recommended Specification for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

1.2.1.1 Design Analysis

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the building, its components, and the foundations. Foundations shown on the drawings are based on loads derived from a representative set of similar building types. The Contractor shall obtain the services of a licensed Professional Engineer to verify that the foundations shown are adequate for the building supplied using the criteria in paragraph Foundations. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included. Computer program output shall be annotated and supplemented with sketches to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer, who shall function as a point of contact to answer questions during the detail drawing review.

1.2.1.2 Dimensions

Building dimensions shall be as standard with manufacturer, not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of finished floor to intersection of insides of roof and sidewall sheets. The clear height between finished floor and bottom of roof steel shall be as indicated.

1.2.1.3 Framing

Provide building with vertical walls and gable roof. Building shall be single-span structures with one of the following framing systems: self-framing rigid frame type, similar to AISC 360, Type I construction. End walls shall be of rigid frame. Roof slope shall be as shown.

1.2.1.4 Foundation Requirements

Design foundations for allowable soil bearing pressure and a minimum bottom of footing depth as indicated. Use a factor of safety of 1.5 for overturning, sliding and uplift, a concrete compressive strength as specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE. The foundation loads are supplied by the building manufacturer.

1.2.2 Performance Requirements

MBMA MBSM, for loading combinations and definitions with the exceptions of wind load and special collateral loads. Design for each material shall be as specified by the Design Authority as listed in MBMA MBSM.

1.2.2.1 Dead Loads

The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

1.2.2.2 Roof Live Loads

a. Uniform Loads: Uniform roof live loads, including maintenance traffic and construction loads, shall be determined and applied in accordance with ASCE 7.

b. Concentrated Loads: In addition to ASCE 7 roof live loads, a minimum design concentrated load of 1335 N shall be used to simulate a construction load on roof panels. The concentrated load shall be applied at the panel midspan and shall be resisted by a single standing seam metal roof panel, or a 610 mm wide corrugated metal panel, assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.2.2.3 Roof Snow Loads

Design roof snow loads 1.49 kPa at Ground snow load, including effects of drifting, shall be determined and applied in accordance with ASCE 7.

1.2.2.4 Wind Loads

Basic wind speed and multiplying factors are as follows:

a.	Basic Wind Speed (3 second gust)	135 km/hr (90 mph)
b.	Importance Factor (I)	1.0
c.	Exposure Category	D

1.2.2.5 Seismic Loads

a.	Seismic Occupancy Category	II
b.	Importance factor	1.0
c.	Site Class	D
d.	Seismic Design Category	D
e.	Short Acceleration (Ss)	1.28
f.	One Second Acceleration (S1)	0.51

1.2.2.6 Collateral Loads

Collateral load of 0.50 k Pa shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as sprinklers, mechanical systems, electrical systems, hung/operable partitions, and ceilings. This allowance does not include the weight of hung equipment weighing 25 kg or more. Equipment loads of 25 kg or more shall be shown on the shop (detail) drawings and the structure (frame,

purlins, girts) shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 25 kgs before design of the building commences. Training Building operable partitions loads shall be applied at 45 kg/linear meter or as required.

1.2.2.7 Deflection

a. Structural Members: The maximum deflection of main framing members shall not exceed 1/240th of their respective spans except deflection of framing supporting operable partitions shall not exceed a maximum total deflection of 25 mm. The maximum deflection due to live load in roof panels and purlins shall not exceed 1/180th of their respective spans.

b. Roof Panels: UL 580, Class 90. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition, the roof decking shall be designed for a 90 kg concentrated load at midspan on a 300 mm wide section of deck. Lateral drift for the pre-engineered building system shall be limited to that compatible with the CMU exterior wall enclosure, but in no case shall it be less than H/180. Roof panels are not permitted to be used as diaphragms to resist seismic forces. Cables are not acceptable therefore horizontal X-bracing rods are required.

c. Wall Panels: The maximum deflection due to wind on wall panels and girts shall be limited to 1/120th of their respective spans except that when interior finishes are used the maximum allowable deflection shall be limited to 1/180th of their respective spans.

d. Openings: Limit deflections of steel framing above and along the side of rolling door openings to a maximum of 1/2 the allowable movement in the telescoping top roller of the doors to ensure proper operation. Frame all equipment openings over 300 by 300 mm.

1.2.2.8 Provisions for Gutters and Downspouts

Gutters and downspouts shall be designed according to the requirements of SMACNA Arch. Manual for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads. Roof drainage system to withstand rainfall intensity of 50 mm/hour, with 5 minute duration.

1.2.2.9 Provisions for Louvers

Louvers shall be fixed-blade type designed for a minimum net open area as shown, to be rainproof, and to resist vibration when air is passed at the rate of 4 cubic meters per second.

1.2.2.10 Drift Provisions

Lateral deflections, or drift, at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force

resisting elements, shall conform to the more stringent of MBMA MBSM, h/500 and 6mm at 3000 mm above floor in transverse and longitudinal directions.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Preengineered Building; G

Template for anchorage

Submit as necessary to erect the building and install components.

SD-03 Product Data

Preengineered metal building materials

Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

Instruction Manuals

Erection

Qualifications

SD-04 Samples

Factory color finish

Accessories

Roofing and Siding

Fasteners

Insulation

Gaskets and Insulating Compounds

Sealant

Skylights

Wall Liners

Roof Curbs

SD-05 Design Data

Building; G

Foundation loads; G

Anchor bolts; G

Purlins and girts; G

Bracing; G

SD-06 Test Reports

Factory Color Finish

Insulation

SD-07 Certificates

Preengineered metal building materials

Submit certificates attesting that materials comply with this specification.

SD-10 Operation and Maintenance Data

Preengineered Building, data package 1; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Qualifications of the manufacturer, the manufacturer's Representative when one is used, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

1.4.1.1 Manufacturer

The manufacturer shall have AISC FCD, category MB certification.

1.4.1.2 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.4.1.3 Manufacturer's Representative

A representative designated by the building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction, from the start of the structural framing erection until completion of the installation of the exterior covering, to assure that the building is erected properly.

1.4.2 Regulatory Requirements

1.4.2.1 Drawings: Preengineered Building

Submit complete design drawings for the preengineered building. Submit drawings for the foundations and anchorage.

1.4.2.2 Design Data Building

Submit design calculations for the entire preengineered building and foundations, prepared and stamped by a professional engineer. Also submit for components requested, and stamp with the seal of a professional engineer. Include sizes and location of anchor bolts.

1.4.3 Coordination Meeting

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal building system contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing/metal building system manufacturer, the roofing/metal building supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

1.4.4 Instructions

1.4.4.1 Instruction Manuals

Manufacturer's literature for individual building component systems.

1.4.4.2 Erection

Manufacturer's erection instruction and erection drawings describing the preparation requirements, assembly sequence, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components.

1.4.5 Samples

1.4.5.1 Factory color Finish

Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the Contracting Officer.

1.4.5.2 Accessories

One sample of each type of curb, flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

1.4.5.3 Roofing and Siding

One piece of each type and finish (exterior and interior) to be used, 225 mmlong, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

1.4.5.4 Fasteners

Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

1.4.5.5 Insulation

One piece of each type to be used, and descriptive data covering installation.

1.4.5.6 Gaskets and Insulating Compounds

Two samples of each type to be used and descriptive data.

1.4.5.7 Sealant

One sample, approximately 0.5 kg, and descriptive data.

1.4.5.8 Wall Liners

One piece, 225 mm long, full width.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle manufactured items so that materials remain dry and undamaged. Do not store in contact with materials that might cause staining.

1.6 WARRANTIES

1.6.1 Warranty

The Metal Building System, composed of framing and structural members, roofing and siding, gutters and downspouts, accessories, fasteners, trim, and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.6.2 Prime Contractor's Weathertightness Warranty

The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship

deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include but is not limited to the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR METAL BUILDING SYSTEMS, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

1.6.3 Manufacturer's Material and/or System Weathertightness Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2224. Liability under this warranty is exclusively limited to replacing the defective coated material.

PART 2 PRODUCTS

2.1 WALL AND ROOF MATERIALS

MBMA MBSM except as specified otherwise herein. Design roof and wall panels, accessories, and flashings to be completely weathertight and free of abrasions, loose fasteners, and deformations. Each piece or part of the assembly shall be clearly and legibly marked to correspond with the drawings.

2.1.1 Minimum Thickness

As required to conform to design requirements but not less than the following:

Items	Minimum Thickness (Uncoated)
Steel Structural Members Other Than Roof and Wall Panels	18 Manufacturer's Standard (MFG STD) gage, 1.2 mm
Roof and Wall Panels	
Steel	26 MFG STD gage, 0.5 mm
Aluminum	0.8 mm
Plastic	1.1 mm
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, and Liner Panels	
Steel	26 MFG STD gage, 0.5 mm
Aluminum	0.8 mm
Plastic	1.1 mm
Interior Gutters	
Steel	24 MFG STD gage
Aluminum	1 mm
Eave Gutters and Downspouts	
Steel	26 MFG STD gage, 0.5 mm
Aluminum	0.8 mm
Roof Ventilators	
Steel	26 MFG STD gage, 0.5 mm
Aluminum	0.8 mm
Louvers	
Steel	18 MFG STD gage, 1.2 mm
Aluminum	1.6 mm
Girders and Columns	5 mm
Purlins and Girts	14 Manufacturer's Standard gage (MFG STD)
Roof Panels	
Steel	22 MFG STD gage
Aluminum	1 mm
Wall Panels	
Steel	24 MFG STD gage

Aluminum	0.8 mm
Bracing	5 mm thick steel members
Column Base Plates	16 mm thick
Column Anchor Bolts	16 mm diameter
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, and Liner Panels	
Steel	24 MFG STD gage
Aluminum	0.8 mm
Plastic	1.1 mm
Eave Gutters and Downspouts	
Steel	24 MFG STD gage
Aluminum	0.8 mm
Louvers	
Steel	18 MFG STD gage
Aluminum	1.6 mm
Curbs	
Steel	2.00 mm
Aluminum	2.28 mm

2.1.2 Panels

a. Fabricated of zinc-coated steel or aluminum/zinc-coated steel.

b. Preformed.

c. Factory-insulated to provide weathertight joint upon installation.

d. If designed as diaphragm, roof decks shall be designed in accordance with SDI DDMO3.

2.1.2.1 Zinc-Coated Steel Sheet

ASTM A 755/A 755M, Coating Class Z 350 or ASTM A 653/A 653M, SQ, Grade 33, Coating Class Z 350.

2.1.2.2 Aluminum/Zinc-Coated Steel Sheet

ASTM A 792/A 792M, AZ 55

2.1.3 Wall Liners

Wall liners shall be 0.6 mm thick minimum for aluminum or 0.45 mm thick minimum for steel with the same composition specified for panels or siding, and formed or patterned to prevent waviness and distortion, and shall extend from floor to the ceiling or as indicated. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have manufacturer's standard finishes. Colors shall be selected from by the

Contracting Officer from the manufacturer's standard finishes submitted by the Contractor.

2.2 FRAMING AND STRUCTURAL MEMBERS

2.2.1 Steel

ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M.

2.2.2 Galvanized Steel

ASTM A 653/A 653M, G 90 coating designation, 0.045 inch minimum thickness.

2.2.3 Structural Tube

ASTM A 500 or ASTM B 221M.

2.3 ACCESSORIES

2.3.1 Caps, Strips, and Plates

Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories from the same material and gage as the roof panels. Wall plates, base angles or base channels, and other miscellaneous framing members may be standard structural steel shapes, or may be formed from steel not lighter than 1.2 mm thick.

2.3.2 Closure Strips

Provide closure strips of closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering. Closure strips shall not absorb or retain water.

2.3.3 Sealant

Provide elastomeric type sealant containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.3.4 Gaskets and Insulating Compounds

Provide nonabsorptive gaskets and insulating compounds suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.3.5 Fasteners

Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for aluminum wall and roof panels shall be aluminum or corrosion resisting steel. Fasteners for structural connections shall provide both tensile and shear strength of not less than 3.3 kN per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 10 mm for structural

connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 3 mm thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be manufacturer's standard for the system provided.

2.3.5.1 Screws

Provide self-tapping screws not less than No. 14 diameter and not less than No. 12 diameter if self-drilling/self-tapping type.

2.3.5.2 End-Welded Studs

Provide automatic shouldered type studs with a shank diameter of not less than 5 mm and cap or nut for holding covering against the shoulder.

2.3.5.3 Blind Rivets

Provide aluminum rivets with 5 mm nominal diameter shank or stainless steel rivets with 3 mm nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Provide hollow stem rivets with closed ends.

2.3.5.4 Bolts

Provide bolts not less than 6 mm diameter, shouldered or plain shank as required, with proper nuts.

2.3.6 Gutters

Provide complete with mitered corners, end pieces, and special pieces that may be required. Expansion-type slip joints shall be provided at the center of the runs and at intervals of not more than 9800 mm for aluminum and not more than 12 200 mm for steel. Provide water tight seal at all other joints. Provide gutters below the slope line of the roof, to allow snow and ice to slide clear. Provide hangers and fastenings from a metal compatible with the gutters. Space hangers not more than 900 mm apart.

2.3.7 Downspouts

Provide cross sectional area not less than the size of gutter indicated and complete including elbows and offsets. Provide downspouts in approximately 3000 mm lengths; end joints shall telescope not less than 12 mm, and longitudinal joints shall be locked. Provide gutter outlets with stainless steel wire ball strainers of a standard type. Position downspouts not less than 12 mm away from walls and fasten to the walls at top, bottom, and at not to exceed 1500 mm centers intermediately between with manufacturer's standard type leader straps, or concealed type fasteners. Form straps and fasteners from a metal compatible with the downspouts. Provide open downspout.

2.3.8 Louvers

Provide louvers and frames of the sizes, design, and color indicated. Provide the same finish specified in paragraph entitled "Finish". Fold or bead blades at the edges, set at an angle to exclude driving rains, and secure to the frames by riveting or welding as standard with manufacturer.

Provide mullions for louvers over 1200 mm in width; provide not less than one mullion for each 1200 mm width. Provide flanges on the interior face of frames where air intakes or exhaust louvers are indicated to be connected with mechanically-operated dampers or metal ductwork. Provide woven wire bird screening, not less than 8.5 by 8.5 mm mesh per square meterin rewirable frames, on the interior of louvers; install screen frames by means of clips to allow easy removal for cleaning and rewiring. The screens and frames shall be of the same type metal as the louvers; screen wire shall be not less than 1.2 mm in diameter. Provide framing and flashings as necessary for installation of louvers.

2.3.9 Insulation

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 24 degrees C in accordance with ASTM C 518. Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. Roof and wall insulation, including facings, shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 450 when tested in accordance with ASTM E 84. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.3.9.1 Blanket Insulation

Blanket insulation shall conform to ASTM C 991 9.6 kg per cubic m fiber-glass as standard with the metal building manufacturer having a factory-applied facing on one side and a permeance rating of 0.05 or less when tested in accordance with ASTM E 96.

a. Facing on insulation shall be vinyl-scrim foil, facing may be 0.05 mm thick aluminum foil. Vinyl-scrim foil shall have a tensile strength of not less than 178 N machine direction and 134 N cross machine direction when tested in accordance with ASTM D 828.

b. The insulation, including facings, shall have a flame spread rating of 25 or less and a smoke development factor of 150 or less when tested in accordance with ASTM E 84.

c. Wall insulation shall have guarded hot box values for "R" of R17 minimum or more as measured in accordance with ASTM C 1363 test method. Roof insulation shall have guarded hot box values for "R" of R25 minimum or more as measured in accordance with ASTM C 1363.

2.3.9.2 Insulation Retainers

Retainers shall be type, size and design necessary to adequately hold the insulation and to provide a neat appearance. Metallic retaining members shall be nonferrous or have a nonferrous coating. Nonmetallic retaining members, including adhesives used in conjunction with mechanical retainers or at insulation seams, shall have a fire resistance classification not less than that permitted for the insulation.

2.3.10 Vapor Retarder

2.3.10.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 1.15 ng per Pa-second-square meter or less when tested in accordance with ASTM E 96. Facing shall be white reinforced polypropylene kraft laminate (PSK). Facings and finishes shall be factory applied.

2.3.10.2 Vapor Retarders Separate from Insulation

Vapor retarder material shall be polyethylene sheeting conforming to the requirements of ASTM D 4397. A single ply of 0.25 mm polyethylene sheet; or, at the option of the Contractor, a double ply of 0.15 mm polyethylene sheet shall be used. A fully compatible polyethylene tape shall be provided which has equal or better water vapor control characteristics than the vapor retarder material. A cloth industrial duct tape in a utility grade shall also be provided to use as needed to protect the vapor retarder from puncturing.

2.3.11 Doors and Windows

Doors and windows are specified in Specification Sections 08 11 13 "STEEL DOORS AND FRAMES", and Specification Section 08 51 13.00 20 "ALUMINUM WINDOWS". Provide framing members and flashings as necessary for installation of the doors and windows.

2.3.11.1 Swinging Personnel Doors and Frames

SDI/DOOR A250.8, Grade II, Model 1, 2, 3, or 4, design as indicated, zinc-coated and shop primed, exterior mounting. Hardware is specified in Section 08 71 00 DOOR HARDWARE. Doors shall be provided with the following hardware:

2.3.11.2 Overhead Coiling Doors

Overhead coiling doors shall conform to the requirements of Section 08 33 23 OVERHEAD COILING DOORS.

2.3.12 Sealant

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be clear and shall cure to a rubber like consistency.

2.3.13 Gaskets and Insulating Compounds

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.3.14 Roof Curbs

Provide metal roof curbs internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joint, with integrel metal cant or stepped integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate

configuration and dimensions with rough in information or shop drawings of equipment to be supported.

2.4 FINISH

2.4.1 Shop Painting

Ferrous metal work, except factory-finished work, zinc-coated work, aluminum-coated work, and work specified to be painted herein, shall be (1) cleaned of dirt, rust, scale, loose particles, grease, oil, and other deleterious substances; (2) phosphate treated; and (3) then be given one coat of an approved rust-inhibiting primer paint of the type standard with the metal building manufacturer.

2.4.2 Factory Color Finish

Provide exterior and interior exposed surfaces of metal roof and wall panels, louvers, gutters, downspouts, and metal accessories with a thermal-cured factory finish. Color shall be selected from manufacturer's standard colors. Provide an exterior finish top coat of 50 percent resin silicone polyester. Provide standard dry film thickness of 0.025 mm for exterior coating exclusive of primer. Provide exterior primer thickness 0.02 mm. Interior color finish shall consist of the same coating and dry film thickness as the exterior. Provide exterior color finish meeting the test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided.

2.4.3 Testing of Factory Color Finishes

2.4.3.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610 and a rating of 6, over 2.0 to 3.0 mm failure at scribe, as determined by ASTM D 1654.

2.4.3.2 Accelerated Weathering Test

ASTM G 23, Method 2, Type D apparatus minimum 2000 hours or Type EH apparatus minimum 500 hours, no checking, blistering or loss of adhesion; color change less than 5 NBS units by ASTM D 2224 and chalking less than No. 8 rating by ASTM D 4214.

2.4.3.3 Flexibility

ASTM D 522, Method A, 1/8 inch diameter, 180 degree bend, no evidence of fracturing to the naked eye.

2.4.3.4 Adhesion

ASTM D 3359, Method B, for laboratory test and film thickness less than 5 mil and Method A for site tests. There shall be no film removed by tape applied to 11 parallel cuts spaced 1/8 inch apart plus 11 similar cuts at right angles.

2.4.3.5 Impact

ASTM D 2794, no loss of adhesion after direct and reverse impact equal to 1.5 times metal thickness in mils, expressed in inch-pounds.

2.4.3.6 Humidity Resistance

ASTM D 2247, 1000 hours, no signs of blistering, cracking, creepage or corrosion on score panel.

2.4.3.7 Specular Gloss

ASTM D 523, finished surfaces exposed to the building exterior shall have a specular gloss of 10 measured at an angle of 85 degrees.

2.4.3.8 Abrasion

ASTM D 968, Method A, falling sand shall not expose substrate when tested in quantities 13.2-15.9 gallons of sand per mil of thickness.

2.4.3.9 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 3 mm diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.4.3.10 Pollution Resistance

Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

PART 3 EXECUTION

3.1 INSPECTION

Check concrete dimensions, anchor bolt size and placement, and slab elevation with the metal building manufacturer's templates and drawings before setting any steel.

3.2 ERECTION

Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Contracting Officer. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems and accessories, install curb, closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide an anchored weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

3.2.1 Dissimilar Materials

Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:

a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.

b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.

c. Provide an approved nonabsorptive gasket.

d. Apply an approved calking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a). Paint green or wet wood, or wood treated with incompatible wood preservatives, by method (a) or use two coats of aluminum paint.

3.2.2 Rigid Frames, Bases, and Sill Members

Brace frames as necessary to ensure safety. Set accurately, using a nonshrink grout to obtain uniform bearing on the concrete and to maintain a level base line elevation. Separate leveling plates under column base plates shall not be used. Members shall be accurately spaced to assure proper fitting of panels. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses. Supports for electric overhead traveling cranes shall be positioned and aligned in accordance with CMAA 70. Clean surfaces to receive the mortar and thoroughly moisten immediately before placement of mortar. Water cure exposed surfaces of mortar with wet burlap for 7 days.

3.2.2.1 Field Welding

Steel, AWS D1.1-D1.1M.

3.2.2.2 Field Bolting

AISC S329. Improper or mislocated bolt holes in structural members or other misfits caused by improper fabrication or erection, shall be repaired in accordance with AISC 303. Concrete work is specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE. Anchor bolts shall be accurately set by template while the concrete is in a plastic state.

3.2.3 Wall Construction

Apply panels full wall heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Lay side laps away from the prevailing winds. Seal side and end laps with the joint sealing material recommended by the manufacturer. Flash or seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Flashing will not be required where approved "self-flashing" panels are used. Minimum end laps for all types of panels shall be 64 mm. Minimum side laps for all types of panels shall be one corrugation, one configuration, or an interlocking joint. Install liner panels to height indicated .

3.2.4 Roof Construction

Apply the roofing panels in the longest lengths obtainable with end laps occurring only at structural members with no transverse joints except at the junction of ventilators, curbs, light transmitting roof panels, chimneys, and similar openings. Lay side laps away from the prevailing wind, and seal side and end laps with joint sealing material. Flash and seal the roof at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary. Minimum side lap shall be one corrugation, configuration, or interlocking rib except 1 1/2 corrugations for standard corrugated sheets. End laps shall not be less than 150 mm and shall occur only over purlins.

3.2.5 Installation of Gutters and Downspouts

Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 400 mm maximum. Spacing of brackets and spacers for gutters shall be 1 m maximum. Supports for downspouts shall be spaced according to manufacturer's recommendations.

3.2.6 Louvers and Ventilators

Louvers and ventilators shall be rigidly attached to the supporting construction to assure a weather tight installation.

3.2.7 Doors and Windows

Doors and windows, including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors and windows shall be sealed according to manufacturer's recommendations to provide weathertight construction.

3.2.8 Minimum Fastener Spacing

Space fasteners according to manufacturer's instructions, but not to exceed:

a. 200 mm o.c. at end laps of covering,

b. 300 mm o.c. at connection of covering to intermediate supports,

c. 300 mm o.c. side laps of roof coverings, 450 mm o.c. at side laps of wall.

3.2.9 Installation of Insulation

3.2.9.1 Roof Insulation

Install over purlins before roof coverings are applied. Hold insulation rigid until secured in place. Insulation facing shall be exposed on the interior side of the building. Fold and staple facing tabs of insulation on 150 mm centers, from exterior side of building to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets , and cover side laps of insulation with metal strips formed for this purpose and paint to match the facing material. Install the strips spanning from purlin to purlin and in accordance with the metal building manufacturer's recommendations.

3.2.9.2 Wall Insulation

Install over girts before wall coverings are applied. Hold insulation rigid until secured in place. Expose facing toward the interior side of the building. Fold and staple facing tabs of insulation on 150 mm centers, from exterior side of building, to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets, and cover side laps of insulation with metal strips formed for this purpose and paint to match the facing material. Install the strips spanning from girt to girt and in accordance with the metal building manufacturer's recommendations.

3.2.10 Vapor Retarder Installation

3.2.10.1 Integral Facing on Blanket Insulation

Integral facing on blanket insulation shall have the facing lapped and sealed with a compatible tape to provide a vapor tight membrane.

3.2.10.2 Polyethylene Vapor Retarder

The polyethylene vapor retarder membrane shall be installed over the entire surface. A fully compatible polyethylene tape shall be used to seal the edges of the sheets to provide a vapor tight membrane. Sheet edges shall be lapped not less than 150 mm. Sufficient material shall be provided to avoid inducing stresses in the sheets due to stretching or binding. All tears or punctures that are visible in the finished surface at any time during the construction process shall be sealed with polyethylene tape.

3.2.11 Wall Liner

Wall liner shall be securely fastened into place in accordance with the manufacturer's recommendation and in a manner to present a neat appearance.

3.2.12 Roof Curbs

Set roof curb so top surface of roof curb is level.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same color and material used for the shop coat. Section 09 90 00 PAINTS AND COATINGS, for painting of shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows.

3.4 FIELD QUALITY CONTROL

At the discretion of the Contracting Officer, sample panels may be taken at random from each delivery or from stockpiles on the site at any time during the construction period, and tests may be made to check the conformance of the materials to the requirements specified in paragraph entitled "Factory Color Finish." Failure of the sample sheets to pass the required tests shall be cause for rejection of all sheets represented by the samples and replacement of the entire shipment.
-- End of Section --

SECTION 13 48 00

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2006) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2005) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 500	(2003a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2004a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2006) Standard Specification for Carbon and Alloy Steel Nuts (Metric)

ASTM A 572/A 572M	(2006) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603	(1998; R 2003) Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(2006a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-03A	(2005) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems outlined in Section 22 00 00 PLUMBING, GENERAL PURPOSE, the electrical equipment and systems outlined in Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. Seismic protection requirements shall be in accordance with UFC 3-310-03A and additional data furnished by the Contracting Officer, and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group I building occupancy and on site response coefficients for S_{MS} and S_{M1}. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in Chapter 3 of UFC 3-310-03A, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas shall be required.

1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

- Storage cabinets
- Storage Racks
- Shelving
- Partitions
- Ornamentations
- Signs and Billboards
- Furnishings

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Bracing; G
Resilient Vibration Isolation Devices; G
Equipment Requirements; G

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Bracing; G
Equipment Requirements; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

Rigidly mounted equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-03A, Chapter 10. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

1.4.2 Nonrigid or Flexibly-Mounted Equipment

Non-rigid or flexibly mounted equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 5 times the operating weight of the equipment at the vertical center of gravity of the equipment.

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2 for bolts and ASTM A 563M for nuts for bolts and nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

2.2 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A 36/A 36M, Grade 503. If the Contractor does the design, both ASTM A 36/A 36Mand ASTM A 572/A 572M, grade 503 will be allowed.

b. Wire rope, ASTM A 603.

c. Tubes, ASTM A 500, Grade B.

d. Pipes, ASTM A 53/A 53M, Type E or S, Grade B.

e. Light gauge angles, less than 6 mm thickness, ASTM A 653/A 653M.

PART 3 EXECUTION

3.1 BRACING

Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 13 mm bolts.

3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

3.3.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. One nut shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.3.2.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.3.2.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 9 mm sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.3.2.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 13 mm.

3.4.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or slab-mounted equipment. These snubbers shall provide 6 mm free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 50 by 50 mm by 16 gauge and one diagonal angle of the same size.

3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (millimeters)	Maximum Length* (meters)
Angles	38 x 38 x 6	1.5
	50 x 50 x 6	2.0
	64 x 38 x 6	2.5
	75 x 64 x 6	2.5
	75 x 75 x 6	3.0
Rods	91	1.0
	22	1.0
Flat Bars	38 x 6	0.4
	50 x 6	0.4
	50 x 10	0.5
Pipes (40s)	25	2.0
	32	2.8
	40	3.2
	50	4.0

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 13 mm bolts. Sufficient braces shall be provided for equipment to resist a horizontal force as specified in Chapter 10 of UFC 3-310-03A without exceeding safe working stress of bracing components. The Contractor shall provide, for approval, specific force calcualtions in accordance with Chapter 10 of UFC 3-310-03A for the equipment in the project. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.6.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
04/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999; R 2001) Relief Valves for Hot Water Supply Systems

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

ASHRAE 90.1 - IP	(2004; Addendas a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,r,s,t,u,v,x,ak 2006; Supp to Addendas 2006; Errata 2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition
ASHRAE 90.1 - SI	(2004; Addendas a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,r,s,t,u,v,x,ak 2006; Supp to Addendas 2006; Errata 2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, SI Edition

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
ASSE 1005	(1999) Water Heater Drain Valves 3/4 Inch Size
ASSE 1010	(2004) Water Hammer Arresters
ASSE 1011	(2004; Errata 2004) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	(2005) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1019	(2004; Errata 2005) Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type

ASSE 1020	(2004; Errata 2004) Pressure Vacuum Breaker Assembly
ASSE 1037	(1990) Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.19.1M	(1994; R 2004) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.3	(2000: R 2004) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001) Standard for Floor and Trench Drains
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose (Inch)
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.4	(1998) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(2004) Control and Safety Devices for Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2005) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 183	(2003) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2006a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 515/A 515M	(2003) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2006) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 733	(2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(2006) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 888	(2005) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 152/B 152M	(2006a) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1004	(2003) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2006a) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2665	(2004e2) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D 2672	(1996a; R 2003) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2822	(2005) Asphalt Roof Cement
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a; R 2003e1) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3311	(2006a) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(2001) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4551	(1996; R 2001) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM D 638	(2003) Standard Test Method for Tensile Properties of Plastics
ASTM E 1	(2003a) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 1760	(2001) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(2002e1) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI 310	(2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

UPC	(2003) Uniform Plumbing Code

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2003; Errata 2003; Errata 2004; Errata 2004; Errata 2005) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ISEA Z358.1	(1998) Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(2006) Steel Pipeline Flanges
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002a; R 2004) Standard for Butterfly Valves
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-70	(2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78	(2005a) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2006) Standard for Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-85	(2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2006; Errata 2006) Installation of Oil Burning Equipment
NFPA 58	Liquified Petroleum Gas Code 2004 Edition
NFPA 90A	(2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14	(2006) Plastics Piping System Components and Related Materials
NSF 61	(2005; Addendum 2005) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1998) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(1992) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(1997) Hose Clamp Specifications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5	(2000; E 2004) White Metal Blast Cleaning

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System
PL 93-523	(1974; A 1999) Safe Drinking Water Act

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

10 CFR 430	Energy Conservation Program for Consumer Products
21 CFR 175	Indirect Food Additives: Adhesives and Components of Coatings
40 CFR 50.12	National Primary and Secondary Ambient Air Quality Standards for Lead
PL 102-486	(1992) Residential Energy Efficiency Ratings

UNDERWRITERS LABORATORIES (UL)

UL 174	(2004; Rev thru May 2006) Household Electric Storage Tank Water Heaters
UL 1951	(1994) Standard for Electric Plumbing Accessories
UL 499	(2005; Rev thru Mar 2006) Electric Heating Appliances
UL 732	(1995; Rev thru Feb 2005) Oil-Fired Storage Tank Water Heaters

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having a "FIO" designation are For Information only and for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; GA

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail

drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

For the following equipment to be provided under this contract the contractor shall submit the manufacturer's standard catalog data, installation, operation and maintenance manuals:

Water closets; GA
Faucets and trim, all locations; GA
Utility sinks; GA
Water heaters; GA
Hose bibs and wall hydrants; GA
Backflow prevention assemblies; GA
Emergency eyewashes; GA
Shower Faucets; GA
Valves; GA
Drains and Cleanouts; GA
Pipe Insulation; GA
Propane Storage Tanks; GA
Welding; FIO

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; FIO

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection; FIO

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; GA

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is

properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Valves, Faucets, Hydrants, and Fixtures - Submit Data Package 2 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

Water Heaters - Submit Data Package 3 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a

conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.5.1 Welding

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with paragraph 3.1.4.

1.5.3 Plumbing Fixtures

Water flow and consumption rates shall at a minimum comply with requirements in PL 102-486.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. PVC pipe shall contain a minimum of 25 percent recycled content, with a minimum of 15 percent post-consumer recycled content. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as building valves, check valves, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as lavatory faucets, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Cast-iron pipe shall contain a minimum of 100 percent recycled content. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310.

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

e. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

f. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

g. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange

material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphram or piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Hose Clamps: SAE J1508.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. Hypochlorites: AWWA B300.

g. Liquid Chlorine: AWWA B301.

h. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

i. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 22 07 19.00 40 PLUMBING PIPING INSULATION.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71

Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Water Heater Drain Valves	ASSE 1005
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Wall Faucets (HB-1)

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm male inlet threads, hexagon shoulder, and 20 mm hose connection. Faucet handle shall be securely attached to stem.

2.3.2 Wall Hydrants (Frostproof)(WH-1)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm exposed hose thread on spout and 20 mm male pipe thread on inlet.

2.3.3 Relief Valves

Water heaters shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) shall have 20 mm minimum inlets, and 20 mm outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) shall have 25 mm minimum inlets, and 25 mm outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for storage water heaters. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall he constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degrees C (180 degrees F) water temperature.

The following plumbing fixtures shall be provided:

Eastern Water Closet (W-1) with low consumption (6.1 Liter/Flush)flush valve assembly. Provide acid resisting fired porcelain enameled cast iron water closet complete with rotating No-Hub 'P' trap and No-Hub coupling to meet piping requirements. Eastern Style water closet shall be furnished with integral non-skid foot pads and bowl wash down non-splashing flushing rim. The water closet shall be completely self supporting requiring no external mounting hardware and shall be flush with floor. The Eastern Style water closet shall incorporate waterproofing membrane flashing flange. Provide a cold water spigot 300mm above finished floor on the right (from a perspective of standing inside of the cubicle and looking out) sidewall of the cubicle. Toilets shall be oriented north and south. Toilets shall not face east or west.

Lavatories (L-1). All sinks shall be trough type constructed of block and concrete with ceramic tile exterior and lining capable of withstanding abuse.

Lavatories (L-2). Enameled cast iron, wall mounted. Brass fittings provided for water supplies. Faucets shall be chrome plated brass single lever mixing type.

Janitor's Sink (MB-1). Floor mount janitor, enameled cast iron with copper alloy rim guard. Provide hot and cold water valves with manual mixing. Faucet handles shall be copper alloy. Include a stainless steel shelf and three mop holders.

Shower (SH-1). Showerhead and faucet handles shall be copper alloy. Provide for manual mixing with hot and cold water valves. In addition to a shower head, provide each shower stall with a threaded faucet approximately 1.2 m AFF with hot and cold-water controls, mixing valve and a diverter type valve so water can be directed to either the shower or to the lower faucet. Diverter valve shall be factory made for this specific package, by the mixing valve manufacturer. Shower shall be provided with low (9.5 LPM) flow shower head. The shower head shall be surface mounted, heavy duty type and securely fastened to the wall. Shower pan membrane shall be "elastomeric sheet waterproofing membrane" as specified in section 07 13 53 ELASTOMERIC SHEET WATERPROOFING. Pans shall be field fabricated as indicated in section 22 00 00, Part 3 Execution.

Sink (S-1). Single bowl, Type 304, 18-8, 18 gauge stainless steel countertop ledgeback sink, 508 mm x 495 mm x 190 mm deep, three (3) hole punching. Sound deadened. Self rim. Chrome faucet with swing spout; lever handles, and aerator. Stainless steel drain and tailpiece assembly; P-trap; stops. Countertop openings by others.

Sink (S-2): Single bowl, wall mounted, type 302, 18-8, 18 gauge stainless steel, 559mm x 495mm x 190mm deep, three (3) hole punching, with 63mm high backsplash. Two (2) stainless steel wall support brackets, also wall hanger. Sound deadened. Chrome gooseneck faucet with rigid/swing, wrist blade handles, and aerator. Stainless steel drain and tailpiece assembly; P-trap; and stops.

Sink (S-3): Two (2) bowl kitchen sink, complete with trim, furnished and installed by Plumbing Contractor. Completely connected by this contractor.

Sink (S-4): Three (3) bowl kitchen sink, complete with trim, furnished and installed by Plumbing Contractor. Completely connected by this contractor.

Sink (S-5): Pot sink faucet, provide hot and cold water valves with manual mixing. Faucet handles shall be copper alloy.

Sink (UT-1). Single bowl, floor mounted, stainless steel, approximately 600 mm x 600 mm x 350 mm deep. Chrome faucet with vacuum breaker swing spout and hose thread outlet. Drain, tailpiece assembly, drain plug; P-trap; stops. Provide 775 mm hose, hose hanger bracket, and rubber grip. Provide 1m rubber hose.

Emergency Eye and Face Wash Assembly (EW-1). Provide emergency eye and face wash assembly in facilities where appropriate. Provide a drain at each area. Emergency eye and face wash assembly shall be ISEA Z358.1, wall-mounted, self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 0.19 L/S of aerated water at 207 kPa (gage) flow pressure, with eye and face wash nozzles 838 to 1143 mm above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum.

Floor or Shower Drain (FD-1). Cast iron construction with galvanized body, integral seepage pan, and adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. Toilet room floor drains are similar except are provided with built-in, solid, hinged grate.

Funnel/Floor Drain (FD-2). Cast iron construction with galvanized body, with slotted cast iron gate. Drain shall be factory furnished with a cast iron oval funnel assembly, 229 mm diameter.

Funnel/Floor Drain (FD-3). Floor drain construction same as FD-1, except drain shall be factory furnished with a chromium plated bronze, nickel-bronze, or nickel-brass round funnel assembly, 175 mm diameter.

Trench Drain (TR-1). Cast iron construction with galvanized body, integral seepage and adjustable perforated or slotted chromium plated bronze, nickel-bronze, or nickel brass strainer consisting of a grate and threaded collar. This style of drain shall be employed in the kitchen area of the DFACs in response to kitchen cleaning practices of the local national staff. Also, access needs to be provided to the solids collector for routine emptying.

Room hose bibs and floor drains shall be provided as required. Afghan dining facility area clean-up hose bib (HB-2) to be supplied with connecting hose on reel including approximately 12 meters of hose. Provide clean-up spray nozzle on end of hose assembly.

Provide P-Traps per International Plumbing Code IPC for all fixture drains, floor and trench drains, and shower drains. P-traps shall have minimum of 50 mm water seal.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409. Traps shall be with a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm. The interior diameter shall be not more than 3.2 mm over or under the nominal size, and interior surfaces shall be reasonably smooth throughout.

2.7 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 93 degrees C water temperature and 1034 kPa working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.7.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.7.1.1 Electric Type (HWH-1)

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be of KW noted. The elements shall be wired so that only one element can operate at a time. A phenolic resin coating shall be provided as specified herein.

2.7.2 Phenolic Resin Coatings

The phenolic resin coating shall be applied at coating manufacturer's factory. The coating shall be a product specifically intended for use on water heaters and shall be acceptable for use in potable water systems. Steel, copper, copper alloy, or stainless steel coatings shall be capable of withstanding temperatures up to 204 degrees C dry bulb; and meet the requirements of 21 CFR 175. The entire exterior surface shall be coated with three component phenolic resin coating system. The system shall consist of the following: wash primer, pigmented base coat, and the clear top coat. Immediate and final cure times and temperatures shall be as recommended by the coating manufacturer.

2.7.2.1 Sub Title

The wash primer shall be composed of a combination of polyvinyl butyral and a heat hardening phenolic resin. The weight per liter shall be between 0.8388 kg per liter minimum and 0.8867 kg per liter maximum.

2.7.2.2 Pigmented Base Coat

The pigmented baking phenolic base coat shall consist of heat hardening phenolic resins, suitable pigments of the earth type, and softening agents, and shall not contain drying oils or cellulose material. The weight per liter shall be between 1.2 kg per liter minimum and 1.3 kg per liter maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

2.7.2.3 Clear Top Coat

The clear non-pigmented baking phenolic top coat shall have a weight per liter of between 1.0 kg per liter minimum and 1.1 kg per liter maximum. The non-volatile solids content shall be between 48 percent minimum and 52 percent maximum by weight.

2.7.2.4 Certificate of Compliance

A certificate of compliance shall be submitted by the coating manufacturer that documents successful use of coating system under service conditions indicated on the drawings for a minimum of 2 years at three different locations, and that the coating material and application comply with the testing procedures outlined.

2.7.2.5 Test Panels

Steel test panel substrate shall be 0.607 mm in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 0.10 to 0.15 mm, then clear baking phenolic to a total dry film thickness of 0.13 to 0.18 mm. The panels shall then be subjected to the tests specified below:

a. Heat Test: Test panel shall be minimum 70 x 150 mm in size. A coated test panel shall show no cracking, flaking, or other failure after the panel has been tested in accordance with ASTM D 2485, with a furnace temperature of 204 degrees C.

b. Abrasion Test: A coated test panel shall show no more than a 40 milligram loss when tested in accordance with ASTM D 4060, utilizing a Tabor Abraser CS-17F wheel with a 1000 g weight for 1000 cycles.

c. Corrosion Test: A coated test panel shall show no corrosion after being subjected to a 500 hour salt spray test in accordance with ASTM B 117.

2.7.2.6 Hot Water Storage Tank

Hot-water storage tank shall be constructed by one manufacturer; ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1. Tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tank shall be equipped with a pressure gauge 6 inch minimum diameter face. Tank shall include a factory-insulated jacket, with an "R" value of not less than 14. Jacket shall be prime-coated steel or PVC. Storage tank capacity shall be as shown.

2.8 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current

motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.9 MISCELLANEOUS PIPING ITEMS

2.9.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.9.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide 25 mm minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.9.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.9.3 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.9.4 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.9.5 Nameplates

Provide 3.2 mm thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 6.4 mm high normal block lettering into the white core. Minimum size of nameplates shall be 25 by 63 mm. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.10 SPARE PARTS

2.10.1 General Requirements

The contractor shall furnish to the Contracting Officer, fifteen per cent (15%) spare parts of total items installed, as directly coordinated with the Contracting Officer. Spare parts shall include such items as: faucets, flush valves, shower heads, shower mixing valves, hoses, hose valves, spray nozzles, wall hydrant and hose bibb components, backflow preventer parts of each type, fixture stops and traps, heater relief valves, internal valve components for each type of valve, hangers, pipe hammer arrestors, hose clamps, PVC solvent cement, pipe couplings, gaskets, flanges, nuts, bolts, faucet cartridges, pump bearings, pump micro switches, and floor drain and cleanout tops.

2.10.2 Itemizing and Tagging Spare Parts

All spare parts shall be itemized, tagged for future use, and stored by the contractor where directed by the Contracting Officer. Spare parts shall be handled, loaded, unloaded, and stored by the contractor. Final decision of spare part items shall be directly coordinated with the Contracting Officer.

2.11 PROPANE TANKS, PIPING, AND VALVES

Propane tanks (cylindrical bottles), piping, and valve installations shall be furnished and installed under this Contract, including under floor pipe sleeves and sleeve vent piping, in accordance with NFPA 58. Provide standard tank regulating equipment for the bottles. Propane tanks shall be secured in such a manner that they do not move or topple over. The Project will

require that the Contractor provide the agreed to amount of fuel tanks filled with propane fuel at time of completion.

The Contractor shall furnish and install propane gas piping from service entrance tank equipment to the various propane gas-consuming equipment shown. Make final connections to the tanks. Surface mounted piping shall not be susceptible to damage or cause any safety hazards. Piping passing through exterior walls shall be provided with pipe sleeves.

Propane tanks (bottles) shall be of number shown, 100 lb. (45 kilograms) steel construction, with automatic MIG/submerged arc welded gas containment welds. 100% leak tested before/after mechanical valve installation. Large collars, heavy duty footrings, and powder coated finish, free-of-scale interiors. Size of bottle, 1200 mm H. with 163 mm x 128 mm H. collar and 363 mm diameter footring (1238 mm H. overall with cap and flange); providing 89 liters LPG capacity. Manufactured to Department of Transportation specifications.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m outside the building, unless otherwise indicated. A ball valve and drain shall be installed on the water service line inside the building approximately 150 mm above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm (3/4 inch) hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction

of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 100 mm in diameter or larger shall be provided with thrust blocks, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. The base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies, flush valve systems, quick-closing valves, and similar locations with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical or horizontal capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm and smaller; flanges shall be used on pipe sizes 80 mm and larger.

3.1.2.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.4 Plastic Pipe

PVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. Coatings shall be selected, applied, and inspected in accordance with NACE RP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural

members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm; then the sealant shall

be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 150 mm in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 6 to 13 mm wide by 6 to 10 mm deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads. Design for vibration isolation using NEBB TABLES, NEBB Procedural Standards ASHRAE-05, Chapter 42, as applicable. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL.

Pipe Vibration Isolation

Isolators shall be devices with contained chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 10 millimeter.

3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 100 mm and larger when the temperature of the medium is 15 degrees C or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 100 mm.

(2) Be used on insulated pipe 100 mm and larger when the temperature of the medium is 15 degrees C or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm from the pipe fitting

joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Operating temperatures in determining hanger spacing for PVC pipe shall be 49 degrees C for PVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 100 mm and larger when the temperature of the medium is 15 degrees C or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 100 mm a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 100 mm and larger carrying medium less that 15 degrees C a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to

form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the water heater and mounted above and within 150 mm above the top of the water heater.

3.2.2 Installation of Electric Water Heaters

Shall conform to the National Electrical Code Standards. Heat traps shall be installed in the same manner as previously specified for oil heaters.

3.2.3 Phenolic Resin Application Process

The phenolic resin coating shall be applied at the coating manufacturer's factory. The exterior surface shall be coated with the three-component coating system in the following sequence and manner. For immediate and final cure times and temperature, the recommendations of the coating manufacturer shall be followed.

a. Wash Primer. One coat of wash primer shall be applied by flooding.

b. Pigmented Base Coat. Pigmented baking phenolic coating shall be applied in several coats by immersion or flooding to a dry film thickness of 0.10 to 0.15 mm.

c. Clear Top Coat. Clear non-pigmented baking phenolic top coat shall be applied in several coats by immersion or flooding. The final coat may be applied by spraying. The dry film thickness of the total coating system shall be between 0.13 and 0.18 mm.

3.2.4 Heat Traps

Piping to and from each water heater shall be routed horizontally and downward a minimum of 600 mm before turning in an upward direction.

3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.6 Expansion Tanks

A pre-charged expansion tank shall be installed on the cold water supply between each water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure. Valve inlet to each tank.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be

made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 1 m above the floor as directed by the Contracting Officer.

3.3.3 Height of Fixture Rims Above Floor

Lavatories and treatment sinks shall be mounted with rim 775 mm above finished floor. Wall-hung utility sinks shall be mounted with rim 700 mm above the floor.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 6 mm (1/4 inch) thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311.

3.3.10 Shower Pans

3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent

practicable, allowing a minimum of 150 mm for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.10.2 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 150 mm in room areas and 75 mm above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 25 mm of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 50 mm. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 600 or 900 mm at a time shall be welded. On wood subflooring, two layers of 0.73 kg per square meter (15 pound) felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown.

3.5 IDENTIFICATION SYSTEMS

3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m width, 750 mm height, and 12 mm thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm in diameter and the related lettering in 12 mm high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as shown.

3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.7.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.7.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint

shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system shall be designed for the temperature service.

3.7.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 50 degrees C shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.

b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to temperatures between 50 and 205 degrees C shall receive two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.

c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C shall receive two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

3.8 TESTS, FLUSHING AND DISINFECTION

3.8.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Tests. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

e. Propane Gas Supply, Sleeve, and Vent Systems Tests.

3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.8.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 25 mm for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.8.1.3 Eastern Toilet Pans

After installation of the pan and finished floor, the toilet drain outlet shall be temporarily plugged and floor area flooded as described for shower pans, with rejection, repair, or retest as a result in water level drop as described for shower pans.

3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.8.3 System Flushing

3.8.3 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity

of approximately 1.2 meters per second (4 fps) through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 1 L per 24 hour period, ten times over a 14 day period.

3.8.3.1 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - SI for minimum efficiency requirements.Lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Temperature of each domestic hot-water supply.

f. Operation of each floor drain, shower, and Eastern closet by flooding with water.

g. Operation of each vacuum breaker and backflow preventer.

3.8.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C delta T.

SL = Standby loss in W/0.093 sq. m. based on 27 degrees C delta T, or in percent per hour based on nominal 38 degrees C delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.11.1 Storage Water Heaters

3.11.1.1 Electric

a. Storage capacity of 454 liters or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

b. Storage capacity of more than 454 liters or input rating more than 12 kW: maximum SL shall be 1.9 w/0.093 sq. m. per ASHRAE 90.1 - SI, Addenda B.

3.12 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE			
Item #	Pipe and Fitting Materials	A	B	C	D
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X
3	Cast iron drainage fittings, threaded, ASME B16.12	X		X	X
4	Cast iron screwed fittings (threaded) ASME B16.4				X
5	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X

SERVICE:
A - Underground Building Soil, Waste and Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Materials	A	B	D	E	F	G
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a b. Same as "a" but not galvanized for use with Item 4b	X	X	X			
2	Steel pipe:	X	X	X			
	a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B						X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B		X	X			X
3	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X		X			
4	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X		X			
5	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X		X			
6	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 6 and 7	X		X			
7	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X		X			
8	Joints for IPS PVC pipe using solvent cement, ASTM D 2672	X		X			
9	Steel pipeline flanges, MSS SP-44	X		X			
10	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X				
11	Fittings: forged, threaded or socket weld ASME B16.11				X	X	
12	Carbon steel pipe unions,	X	X				X

	socket-welding and threaded, MSS SP-83					
13	Fittings: butt weld			X	X	
14	Malleable-iron threaded pipe unions ASME B16.39	X	X			X
15	Nipples, pipe threaded ASTM A 733	X	X			X
16	Wrought iron pipe, ASTM B36.10M					X

A - Cold Water Service Aboveground
B - Hot and Cold Water Distribution 82 degree C Maximum Aboveground
D - Cold Water Service Belowground
E - Propane Gas in Buildings, Including Sleeves and Vent Piping
Indicated types are minimum wall thicknesses.

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	100 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	50 min. OR	12 kW min.	ASHRAE 90.1 - SI (Addenda B)	SL = 1.9 W/0.09 sq.m. maximum

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 21 degrees C delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).
SL = Standby loss in W/0.09 sq. m. based on 27 degrees C delta T, or in percent per hour based on nominal 32 degrees C delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

-- End of Section --

-- End of Section --

SECTION 22 07 19.00 40

PLUMBING PIPING INSULATION
07/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1136	(2006) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 195	(2000) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(2000) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(2007) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(2007a) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(2007) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C 552	(2003) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 592	(2004) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)

ASTM C 795	(2003) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 2001e1) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM C 921	(2003a) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 579	(2004) Standard Specification for Greige Woven Glass Fabrics
ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(2006) Standard on Types of Building Construction
NFPA 255	(2005; Errata 2006) Standard Method of Test of Surface Burning Characteristics of Building Materials

1.2 PERFORMANCE REQUIREMENTS

Thermal-insulation system materials shall be noncombustible, as defined by NFPA 220. Adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials, except cellular elastomers, shall have a flame-spread classification (FSC) of 25, and a smoke-developed classification (SDC) of 50. These maximum values shall be determined in accordance with ASTM E 84, NFPA 255. Coatings and sealants shall be nonflammable in their wet state.

Adhesives, coatings, and sealants shall have published or certified temperature ratings suitable for the entire range of working temperatures normal for the surfaces to which they are to be applied.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having a "FIO" designation are For Information only and for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings for pipe insulation shall be submitted in accordance with paragraph entitled, "Installation," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Adhesives; FIO
Coatings; FIO
Insulating Cement; FIO
Insulation Materials; FIO
Jacketing; FIO
Tape; FIO

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following.

2.1.1 Adhesives

2.1.1.1 Cloth Adhesives

Adhesives for adhering, sizing, and finishing lagging cloth, canvas, and open-weave glass cloth shall be a pigmented polyvinyl acetate emulsion and shall conform to the requirements of ASTM C 916, Type I.

2.1.1.2 Vapor-Barrier Material Adhesives

Adhesives for attaching laps of vapor-barrier materials and presized glass cloth and for attaching insulation to itself, to metal, and to various other substrates, shall be solvent-base, synthetic-rubber type and shall conform to the requirements of ASTM C 916, Type I, for attaching fibrous-glass insulation to metal surfaces. Solvent shall be nonflammable.

2.1.1.3 Cellular Elastomer Insulation Adhesive

Adhesive for cellular elastomer insulation shall be a solvent cutback chloroprene elastomer conforming to ASTM C 916, Type I, and shall be of a type approved by the manufacturer of the cellular elastomer for the intended use.

2.1.2 Coatings

2.1.2.1 Vapor-Barrier Finishing

Coatings for indoor vapor-barrier finishing of insulation surfaces shall be a pigmented resin and solvent compound and shall conform to ASTM C 1136, Type II.

2.1.2.2 Nonvapor-Barrier Finishing

Coatings for outdoor and indoor nonvapor-barrier finishing of insulation surfaces shall be pigmented polymer-emulsion type recommended by the insulation material manufacturer for the surface to be coated and shall be applied to specified dry-film thickness.

2.1.2.3 Cellular-Elastomer Insulation Coating

Finish coating for cellular-elastomer insulation shall be a polyvinylchloride lacquer approved by the manufacturer of the cellular elastomer.

2.1.3 Insulating Cement

2.1.3.1 General Purpose Insulating Cement

General purpose insulating cement shall be mineral fiber and shall conform to ASTM C 195. Composite shall be rated for 982 degrees C service and shall have a thermal-conductivity maximum of .123 watt per meter per degree Kelvintemperature differential at 93 degrees C mean temperature for 25 millimeter thickness.

2.1.3.2 Finishing Insulating Cement

Finishing insulating cement shall be mineral-fiber, hydraulic-setting type conforming to ASTM C 449/C 449M.

2.1.4 Calking

Calking used with specified insulation materials shall be an elastomeric joint sealant in accordance with ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.5 Corner Angles

Corner angle piping insulation shall be nominal 0.41 millimeter aluminum 25 by 25 millimeter with factory applied kraft backing. Aluminum shall be in accordance with ASTM B 209M, Alloy 3003.

2.1.6 Insulation Materials

Insulation conductances shall be maximum values, as tested at any point, not an average. Insulation conductance found by test to exceed the specified maximum shall either be replaced or augmented by an additional thickness to bring it to the required maximum conductance and a complete finishing system.

2.1.6.1 Mineral Fiber

Mineral fiber shall conform to ASTM C 592, shall be suitable for surface temperatures up to 188 degrees C, and shall be of not less than 64.1 kilograms per cubic meter density. Thermal conductivity shall be not greater than 0.037 watt per meter per degree Kelvinat 66 degrees C mean.

2.1.6.2 Pipe Fittings

Pipe fitting insulation shall be molded pipe fitting covering for use at temperatures up to and including 650 degrees C.

2.1.6.3 Flexible Blankets

Flexible blankets shall be blankets and felts for use at temperatures up to and including 177 degrees Cminimum 16 kilogram per cubic meter density. Thermal conductivity shall be not greater than 0.038 watt per meter per degree Kat 24 degrees Cmean.

2.1.7 Jacketing

2.1.7.1 Glass Cloth Jackets

Glass cloth shall be plain-weave glass cloth conforming to ASTM D 579, Style 141 and shall weigh not less than 0.25 kilogram/square meterbefore sizing. Cloth shall be factory applied wherever possible.

Glass reinforcing cloth shall be a leno weave, 26-end and 12-pick thread conservation, with a warp and fill tensile strength of 7.9 and 5.3 kilonewton per meterof width, respectively, and with a weight of not less than 0.51 kilogram per square meter. At the Contractor's option, Style 191 leno-weave glass cloth conforming to ASTM D 579 may be provided.

2.1.8 Tape

Glass lagging shall be a knitted elastic cloth specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings and shall produce a smooth, tight, wrinkle-free surface. Tape shall conform to requirements of SAE AMS 3779, SAE AMS 3779, ASTM D 579, and ASTM C 921, and shall weigh not less than 0.339 kilogram per square meter.

2.2 PIPING SYSTEMS

Insulation thickness and pipe sizes are in millimeter. Pipe size is inclusive dimensionally, and includes pipe nominal pipe size (NPS) and tubing outside diameter.

2.2.1 Hot-Water Piping

Insulation shall be mineral fiber with glass cloth jacket, Type T-2. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (MILLIMETER)	INSULATION THICKNESS (MILLIMETER)
Up to 100	25
100 to 250	38
250 to 300	50

2.2.2 Cold-Water and Condensate-Drain Piping

Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated. Insulation shall be 10 millimeter mineral fiber with glass cloth jacket, Type T-2.

2.2.3 Refrigerant Suction Piping

Insulation shall be cellular-elastomer, Type T-3. Thickness shall be nominal 20 millimeter. Surfaces, including valve, fittings, unions, and flanges, shall be insulated.

PART 3 EXECUTION

3.1 INSTALLATION OF INSULATION SYSTEMS

Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands, and tapes shall be smoothly and securely pasted down. Adhesives shall be applied on a full-coverage basis.

Insulation shall be applied only to system or component surfaces that have been tested and approved.

Joints shall be tight with insulation lengths tightly butted against each other. Where lengths are cut, cuts shall be smooth and square and without breakage of end surfaces. Where insulation terminates, ends shall be neatly tapered and effectively sealed, or finished as specified. Longitudinal seams of exposed insulation shall be directed away from normal view.

Materials shall be applied in conformance with the recommendations of the manufacturer.

Surfaces shall be clean and free of oil and grease before insulation adhesives or mastics are applied. Solvent cleaning required to bring metal surfaces to such condition shall be provided.

Installation Drawings for pipe insulation shall be in accordance with the adhesive manufacturer's written instructions for installation.

3.2 SYSTEM TYPES

3.2.1 Type T-2, Mineral Fiber with Glass Cloth Jacket

Piping shall be covered with a mineral-fiber, pipe insulation with factory-attached, presized, white, glass cloth. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 40 millimeter. Jacketing bands for butt joints shall be 75 millimeter wide.

Exposed-to-view fittings shall be covered with preformed mineral-fiber fitting insulation of the same thickness as the pipe insulation and temporarily secured in place with light cord ties. Impregnated glass lagging tape shall be installed with indoor vapor-barrier on 50 percent overlap basis and the tape shall be blended smoothly into the adjacent jacketing. Additional coating shall be applied as needed, and rubber gloved to a smooth contour. Ends of insulation shall be taped to the pipe at valves DN50 and smaller. On-the-job fabricated insulation for concealed fittings and special configurations shall be built up from mineral fiber and a mixture of insulating cement and lagging adhesive, diluted with 3 parts water. Surfaces shall be finished with glass cloth or tape lagging.

In lieu of materials and methods specified above, fittings may be wrapped with a twine-secured, mineral-wool blanket to the required thickness and covered with premolded polyvinylchloride jackets. All jacket ends shall be held in place with AISI 300 series corrosion-resistant steel straps, 0.381 millimeterthick by 15 millimeter wide. Fitting insulation shall be thermally equivalent to pipe-barrel insulation to preclude surface temperatures detrimental to polyvinylchloride.

3.2.2 Type T-3, Cellular Elastomer

Piping-system surfaces shall be covered with flexible cellular-elastomer sheet or preformed insulation. Vapor seal shall be maintained. Insulation shall be cemented into continuous material with a solvent cutback chloroprene adhesive recommended by the manufacturer for the specific purpose. Adhesive shall be applied to both of the surfaces on a 100-percent coverage basis to a minimum thickness of 0.254 millimeter wet or approximately 4 square meter per literof undiluted adhesive.

At pipe hangers or supports where the insulation rests on the pipe hanger strap, the insulation shall be cut with a brass cork borer and a No. 3 superior grade cork inserted. Seams shall be sealed with approved adhesive. Sweat fitting shall be insulated with miter-cut pieces of cellular elastomer insulation of the same nominal pipe size and thickness as the insulation on the adjacent piping or tubing. Miter-cut pieces shall be joined with approved adhesive. Covers shall be slit and snapped over the fitting, and joints shall be sealed with approved adhesive.

3.3 ACCEPTANCE

Final acceptance will depend upon providing construction (Record Drawings) details to the Contracting Officer. Construction details shall include, by building area, the insulation material type, amount, and installation method. An illustration or map of the duct routing locations may serve this purpose. Data shall have a cover letter/sheet clearly marked with the system name, date, and the words "Record Drawings insulation/material." Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
07/07

PART 1 GENERAL

1.1 REFERENCES

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

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(2001) Installation Techniques for Perimeter Heating & Cooling; 11th Edition

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201	(2002) Fans and Systems
AMCA 210	(1999; 2001a) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 220	(2005) Test Methods for Air Curtain Units
AMCA 300	(2005) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2005) Methods for Calculating Fan Sound Ratings from Laboratory Test Data

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 260	(2001; Addendum 2002) Sound Rating of Ducted Air Moving and Conditioning Equipment
ARI 350	(2000) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(2001; 2002a) Standard for Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1999) Standard for Central-Station Air-Handling Units
ARI 440	(2005) Standard for Room Fan-Coils and Unit Ventilators
ARI 880	(1998; 2002a) Standard for Air Terminals
ARI 885	(1998) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets

ARI DCAACP	(Online) Directory of Certified Applied Air-Conditioning Products
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.51	(2002) Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms

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

ASHRAE 15	(2004; Errata 2006; Addenda B 2006; Supp to Addenda B 2006) Safety Code for Refrigeration
ASHRAE 52.2	(1999; Errata 2001; Errata 2002; Addendum a 2006; Supp to Addenda a 2006) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2004) Ventilation for Acceptable Indoor Air Quality
ASHRAE 68	(1997) Laboratory Method of Testing to Determine the Sound Power In a Duct
ASHRAE 70	(2006) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 924/A 924M	(2006) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2003) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 152/B 152M	(2006a) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 209	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2006) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 280	(2003) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM C 1071	(2005) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 916	(1985; R 2001e1) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 520	(2000; R 2005) Zinc Dust Pigment
ASTM E 2016	(2006) Standard Specification for Industrial Woven Wire Cloth

ASTM E 84	(2007) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 1040	(1987; R 2007) Standard Specification for Filter Units, Air Conditioning: Viscous-Impingement and Dry Types, Replaceable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2006) Standard for Motors and Generators
NEMA MG 10	(2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 90A	(2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 96	(2004) Ventilation Control and Fire Protection of Commercial Cooking Operations

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

SMACNA FGDCS	(2003, 7th Ed) Fibrous Glass Duct Construction Standards
SMACNA HVAC Duct Const Stds	(1995; Addendum 1997, 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Industry Practice	(1975, 1st Ed) Accepted Industry Practice for Industrial Duct Construction
SMACNA Install Fire Damp HVAC	(2002, 5th Ed) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA Leakage Test Mnl	(1985, 1st Ed) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005) Standard for Factory-Made Air Ducts and Air Connectors

UL 1995	(2005) Standard for Heating and Cooling Equipment
UL 214	(1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films
UL 555	(2006) Standard for Fire Dampers
UL 555S	(1999; Rev thru Jul 2006) Smoke Dampers
UL 586	(2004) Standard for High-Efficiency Particulate, Air Filter Units
UL 705	(2004; Rev thru Mar 2006) Standard for Power Ventilators
UL 723	(2003; Rev thru May 2005) Standard for Test for Surface Burning Characteristics of Building Materials
UL 900	(2004) Standard for Air Filter Units
UL 94	(1996; Rev thru Jun 2006) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL Bld Mat Dir	(2007) Building Materials Directory
UL Electrical Constructn	(2007) Electrical Construction Equipment Directory
UL Fire Resistance	(2007) Fire Resistance Directory Set

1.2 COORDINATION OF TRADES

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Store equipment at the jobsite so that it is protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

1.4 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals having a "FIO" designation are For Information only and for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the

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

SD-02 Shop Drawings

Drawings; GA

Drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and will properly function as a unit on the drawings and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-03 Equipment Submittals

For the following equipment to be provided under this contract the contractor shall submit the manufacturer's standard catalog data, installation, operation and maintenance manuals:

Duct Connectors; FIO
Duct Access Doors; FIO
Manual Balancing Dampers; FIO
Registers and Grilles; FIO
Louvers; GA
Centrifugal Fans; GA
Centrifugal Type Power Wall Ventilators; GA
Centrifugal Type Power Roof Ventilators; GA
Filtered Supply Fans; GA
Heat Pumps; GA
Electric Resistant Heat; GA
Test Procedures; FIO
Duct Insulation; GA
Kitchen Hoods; GA
Make up Air; GA

SD-06 Test Reports

Performance Tests; FIO

Test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

Damper Acceptance Test; FIO

Proposed schedule, at least 2 weeks prior to the start of test.

SD-10 Operation and Maintenance Data

Dampers, Diffusers, Louvers, and Grilles - Submit Data Package 2 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

Proposed on-site training schedule, submitted concurrently with the operation and maintenance manuals.

Powered Equipment - Submit Data Package 3 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide Components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year manufacturer's experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

All equipment shall have a nameplate, installed by the manufacturer, that identifies the manufacturer's name, address, type or style, and model or serial number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Use solid-state variable-speed controllers for motors rated 7.45 kW or less and adjustable frequency drives for larger motors.

2.6 INDOOR AIR QUALITY

All equipment and components furnished as part of this Section shall comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.7 DUCT SYSTEMS

2.7.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Ductwork shall meet the requirements of Seal Class A. Sealants shall conform ASTM E8 and shall be suitable for the range of air distribution and ambient temperatures that it will be exposed to. Do not use pressure sensitive tape as a sealant. Apply the sealant to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 50 mm band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable.

2.7.1.1 General Service Duct Connectors

Provide a flexible duct connector approximately 150 mm in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct

construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.7.1.2 Aluminum Ducts

Provide aluminum ducts at all areas carrying moisture laden air as indicated on the drawings. Ducts shall be ASTM B 209M, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.7.2 Ductwork Accessories

2.7.2.1 Duct Access Doors

Provide hinged access doors conforming to SMACNA HVAC Duct Const Stds in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 375 x 450 mm, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Equip doors 600 x 600 mm or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.7.2.2 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 300 mm. Provide access doors or panels for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.7.3 Registers, and Grilles

Units shall be factory-fabricated of steel or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 0.25 m/s in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be no more than 30 NC or better. Registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers. Where the inlet and outlet openings are located less than 2 m above the floor, they shall be protected by a grille or screen according to NFPA 90A. Units shall be fixed horizontal or vertical louver type. Furnish

registers with sponge-rubber gasket between flanges and wall or ceiling. Locate exhaust registers 150 mm above the floor unless otherwise indicated. Grilles shall be as specified for registers, without volume control damper. Exhaust registers shall have a single set of non-directional face bars or vanes. Set face bars or vanes at 30 degrees.

2.7.4 Insulation

All supply air ducts shall be insulated with Duct Wrap, with vapor retarder facing. The insulation shall have a k-value of 0.24 respectively at 24o C mean temperature. Thickness and R-value of the insulation shall be as installed. Installed thicknesses and R-values shall be based on 25% compression of the wrap. Duct wrap shall be min. 50mm thick.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Fans shall be tested and rated according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested per AMCA 300 and rated per AMCA 301. All fans shall have an AMCA seal. Connect fans to the motors directly. Fan motors located in hazardous areas, as indicated in schedule, shall have motor installed out of air stream, fans shall be explosion proof. Motor sheaves shall be variable pitch for 11 kW and below and fixed pitch as defined by ARI Guideline D. Select variable pitch sheaves to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. For discharge air provide fans with manufactures standard low leakage gravity discharge louvers with security bars. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. Obtain the sound power level values according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated. Power ventilators shall conform to UL 705 and shall have a UL label.

2.8.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved or backward-inclined airfoil design in wheel sizes up to 750 mm. Fan blades for wheels over 750 mm in diameter shall be backward-inclined airfoil design. Fan wheels over 900 mm in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 900 mm or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-

oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Manually operated inlet vanes shall be provided on suction inlets. Manually operated outlet dampers shall be provided. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open drip proof enclosures. Motor starters shall be manual type with weather-resistant enclosure.

2.8.1.2 Centrifugal Type Power Wall Ventilators

Fans shall be direct driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Construct housing of heavy gauge aluminum. Equip unit with an aluminum or plated steel wire discharge bird screen, disconnect switch, anodized aluminum wall grille, manufacturer's standard gravity damper, an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be totally enclosed fan cooled & explosion-proof (where indicated) type. Use only lubricated bearings.

2.8.1.3 Centrifugal Type Power Roof Ventilators

Fans shall be direct driven centrifugal type with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, gravity dampers, roof curb, and extended base. Motors enclosure shall be dripproof type. Kitchen exhaust fans shall be centrifugal type according to UL 705 with direct drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

2.8.1.4 In-line Centrifugal Fans

Welded steel casings, centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards and adjustable motor mounts. Inlet and outlet connections for fan casings to duct work and equipment casings, may be of the slip fit or flanged type. Provide guards for discharges. Air shall enter and leave the fan axially. Inlet shall be streamlined and conversion vanes shall eliminate turbulence and provide smooth discharge air flow. Enclose fan bearings and drive shafts, and isolate from the air stream. Fan bearings shall be mechanically sealed against dust and dirt and shall be self-aligning, pillow block ball or roller type. Motor and drive shall be provided by fan manufacturer.

2.8.1.5 Filtered Supply Fan

For kitchen supply fan. Roof mounted, filtered supply fans shall be direct drive axial type. Propeller construction shall be cast aluminum, airfoil. Propellers shall be statically and dynamically balanced. Fan Hood and base construction shall be aluminum. Hood panels shall be arched with interlocking

seams for weather protection. Fan bases shall be tall to allow for low leakage backdraft dampers. Welded galvanized mesh birdscreens shall be mounted horizontally across the intake area of the hood. Support members shall be heavy gauge galvanized steel angles. Motors shall be heavy duty ball bearing type carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. A standard square key and set screws or tapered locking bushing shall attaché the propeller securely to the motor shaft. Motor support frame assemblies shall be constructed of heavy gauge steel angles. Fan panels shall be heavy gauge steel with formed flanges and double venture. Safety guards of heavy welded wire construction shall be attached to the underside of the fan panel.

2.8.1.6 Prefabricated Roof Curb

For kitchen hood exhaust and supply fan. Curb shall be galvanized steel, with continuous welded corner seams, 50 mm wall thickness, treated wood nailer,.38 mm thick, 48 kg per cubic meter density rigid mineral fiberboard insulation with metal liner, built-in cant strip. Curbs shall be built for pitched roof as required to keep top of curb level. Curb Height shall be 450 mm above finished roof or as required to comply with NFPA 96.

2.8.1.7 Special Construction for Hazardous Area

Explosion Proof:

Construct fans to AMCA 99-0401, Type A spark-resistant requirements where explosion-proof electrical components are specified on drawings or indicated to conform to NFPA 70, Chapter 5 requirements.

2.9 UNITARY EQUIPMENT, SPLIT SYSTEM

Unit shall be an air-cooled, split system which employs a remote condensing unit, a separate indoor unit, and interconnection refrigeration piping. Unit shall be the heat pump type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be provided with necessary fans, air filters, internal dampers, mixing boxes, outdoor connections and cabinet construction as specified. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Condenser or outdoor fans shall be the manufacture's standard for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have totally enclosed enclosures. Thermostat and controls shall be integral with the unit.

2.9.1 Construction

The cabinet and chassis shall be constructed of heavy gauge galvanized steel and designed for easy installation and service access from one side and bottom of unit only (water cooled units require end access). Mounting holes shall be factory attached to the cabinet. Unit shall be wall mounted.

2.9.2 Air Distribution

The air distribution system shall be constructed with a direct-drive fan assembly equipped with double-inlet blower, self-aligning ball bearings, and lifetime lubrication. Fan motor shall be permanent-split capacitor, high efficiency type, equipped with two speeds for air flow modulation.

2.9.3 Filters

The filters shall be rated not less than 20% efficiency based on ASHRAE Dust Weight Arrestance Test. They shall be removable without shutting down the system.

2.9.4 Outdoor Unit, Heat Pump

A. Direct Expansion Coil: The evaporator coil shall have 0.23 sq.m face area. It shall be constructed of copper tubes and aluminum fins. The coil shall be provided with a stainless steel drain pan.

B. Refrigeration System: The refrigeration system shall consist of a scroll (rotary hermetic on 1-ton) compressor with vibration isolating grommets, high pressure safety switch, and externally equalized expansion valve.

C. Air-Cooled Condenser: The condenser coil shall be constructed of copper tubes and aluminum fins and a direct-drive centrifugal fan. No piping, brazing, dehydration or charging shall be required. Condenser electrical connection to the cooling chassis shall be by a factory wired plug. Fan shall be sized to provide full rated cooling capacity at 35°C entering air from plenum space. The system shall be provided with a fan speed control system to permit operation at -28.9°C ambient temperature with low ambient controls and unit frost protection..

2.10 ELECTRIC UNIT HEATERS

UL 1025; Electric unit heaters shall be of the KW rating, voltage and phase specified in the schedule. They shall be fan-forced type, UL approved. Provide control-circuit terminals and single source of power supply. Limit leaving air temperature to 60 degrees C with entering air of 15 degrees C. Include limit controls for overheat protection of heaters. Heating wire element shall be nickel chromium. Provide tamper resistant integral thermostat. Completely factory-prewired to terminal strips, ready to receive branch circuit and control connections for 60 degrees C copper or aluminum wiring. Provide factory-installed safety disconnect switch in the housing with "off" position marking on the face plate. Size of units shall be limited to 5kW only, units over 5kW are not allowed. Provide multiple units to meet needs above 5kW.

2.10.1 Enclosure

Standard unit shall be Minimum 20 gage steel. Explosion proof, corrosion resistant heater shall be NEMA 7, 9 cast aluminum enclosure.

2.10.2 Heating Element (Standard Unit)

Nickel chromium heating wire element, free from expansion noise and hum. Embed element in magnesium-oxide insulating refractory. Seal element in corrosion-resisting metallic sheath with fins. Enclose element ends in terminal box. Provide not more than six fins per 25 mm. Limit fin surface temperature 285 degrees C at any point during normal operation.

2.10.3 Heat Exchanger (Explosion proof/Corrosion Resistant Units)

Nickel Heat exchanger shall be liquid to air design, utilizing a steel tube core with integral aluminum fins. Nontoxic, inhibited, propylene glycol heat

transfer fluid shall be used that provides freeze protection down to -45 degrees C. A pressure relief plug shall be utilized to provide overpressure protection. The heat exchanger shall include industrial grade electric heating elements. Heat exchanger and aluminum fan blade to be enclosed in an industrial grade, corrosion-resistant cabinet. Provide ar high hazard areas as indicated on plans.

2.10.4 Thermostat

Shall be integral and tamper proof.

2.11 SENSORS

NO2 / CO Sensors shall be installed in the vehicle maintenance garages. Hydrogen sensors shall be installed in the Battery Room. Mount sensors at manufacturers recommendations height.

2.11.1 Combination Nitrogen Dioxide and Carbon Monoxide Detector

Provide detectors at areas providing vehicle maintenance. Detector shall be an ETL listed unit containing a control board and sensor board that conforms completely to the UL 3111-1 standard. The NEMA 1 enclosure shall be constructed of heavy polycarbonate plastic, which consists of two pieces, cover and chassis. The cover shall close flush with the sides of the box and shall require a special tool to open it. The sensor module shall be protected from damage inside the enclosure and the cover shall contain screened openings to allow proper sensing. The openings shall conform to the UL 3111-1 standard. The detector shall contain an electro-chemical carbon monoxide (CO) sensor with temperature compensation circuits and an electro-chemical nitrogen dioxide (NO2) sensor. The enclosure shall be provided with four, 13mm (½") pre-punched openings for connection of field conduit. The detector shall include factory-installed wiring that exits the enclosure and allows for installation without the detector being opened. The detector shall be protected against static discharge, excessive electrical noise, and tested for safety in accordance with the UL 3111-1 standard. The detector shall have a 13mm minimum height, liquid crystal display (LCD) that will continually display the current nitrogen dioxide (NO2) and carbon monoxide (CO) level, in parts per million. The detector shall have a green "power" LED, a yellow "sensor-active" LED, a red "low-alert" LED, a red "high-alert" LED and a red "alarm" LED.

2.11.1.1 Switches and Controls

The detector shall provide a 4-20 ma DC, 0-1 VDC, 0-5 VDC or 0-10 VDC signal in direct relationship to the nitrogen dioxide (NO2) and carbon monoxide (CO) gas concentrations. The signal types can be selected at time of order or changed in the field. The detector shall have separate proportional outputs for NO2 and CO levels. An external push button on the front of the enclosure shall be provided to silence the 106 dB internal alarm. The alarm circuit shall become active again, once the detector is no longer at alarm levels. Output relays providing a normally closed set of contacts for the low-alert and for the alarm shall be provided. These relays shall provide a fail-safe that will automatically activate ventilation equipment upon power loss to the sensor. Switches shall be provided for field adjustment of the gas detection level for the low-alert, and of the on/off time delay for the low-alert and high-alert. Selectable CO detection levels shall range from 20 to 55 ppm and

the NO2 detection levels shall range from 0.3 to 4.0 ppm. Selectable time delays shall range from 0 to 7 minutes, in 1 minute increments.

2.11.2 Hydrogen Sensor

Hydrogen sensor shall automatically sense increased levels of hydrogen, should the concentration of hydrogen gas in the air surrounding the sensor reach 1% by volume, the "1% Caution" yellow LED will light and the 1% internal relay will close. Should the hydrogen gas concentration reach 2% by volume, the "2% Warning" red LED will flash and an 80 db alarm will sound; the 1% relay will remain closed and, if a Dual-Relay model, the 2% internal relay will close. Either relay shall activate a remote exhaust fan, turn off battery chargers and alarm. Sensor shall be mounted as high as possible.

2.12 POWER-OPERATED DAMPERS

2.12.1 Frame and Blade Assembly

Frames and blades shall be constructed of galvanized steel.

Resilient seals shall be mechanically attached, field replaceable seals. Attachment by adhesive shall not be acceptable. Jamb seals shall be neoprene.

Frames shall have corner reinforcement and stay rods, where necessary. Frames shall be fabricated by welding or riveting. Damaged galvanized surfaces shall be repaired by coating with an equal weight of zinc.

For static pressures in excess of 750 pascal, master-blade-driven dampers with blades longer than 610 millimeter shall have a maximum blade width of 200 millimeter. Maximum blade width for other services shall be 250 millimeter. Maximum blade length shall be 1220 millimeter. Dampers more than 1220 millimeter wide shall be made in two or more sections with intermediate mullions; each section shall be mechanically interlocked with adjoining section or sections.

Minimum shaft size shall be 15 millimeter, round.

Where linkage is such that operator torque is applied to a master blade and transmitted there from, that blade shall be reinforced and the shaft shall be full length. This type construction shall be limited to 500 pascal, static pressure.

Blades shall be attached to round shafts by hardened cup-point setscrews, or by being pinned. A minimum three-thread engagement shall be provided. Where setscrews are used, two setscrews, 90 degrees apart, shall be provided to secure master blade. Shaft end retainers may be secured by pins or spring washers in grooved shaft or by similar construction.

Frames shall be calked with elastomer compounds to prevent bypass leakage.

Blades without resilient seals shall have interlocking edges.

2.13 SUPPLEMENTAL COMPONENTS/SERVICES

2.13.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE except as modified herein.

2.14 SEISMIC RESTRAINT

2.14.1 Type of Vibration-Isolation Provisions

Design for vibration isolation using NEBB TABLES, NEBB Procedural Standards ASHRAE-05, Chapter 42.

2.14.2 Mountings

Combination spring and rubber-in-shear steel framed for hanger-rod mounting. Minimum total static deflection shall be 25 millimeter.
Air spring with body constructed of reinforced elastomer specifically suitable for application environment. Air spring shall be selected to provide a natural frequency equal to 127 millimeter of deflection of conventional specified steel springs. Facilities shall be provided for dead-level adjustment and height-control of supported equipment.

2.14.3 Duct Vibration Isolation

Isolators shall be devices with contained chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 10 millimeter.

2.15 SPARE PARTS

2.15.1 General Requirements

The Contractor shall furnish to the Contracting Officer, fifteen per cent (15%) spare parts of total items installed, as directly coordinated with the Contracting Officer. Spare parts shall include but not be limited to such items as: fan motors, filters, thermostats, diffusers, registers, grilles, actuators, damper motors.

2.15.2 Itemizing and Tagging Spare Parts

All spare parts shall be itemized, tagged for future use, and stored by the Contractor where directed by the Contracting Officer. Spare parts shall be handled, loaded, unloaded, and stored by the Contractor. Final design of spare part items shall be directly coordinated with the Contracting Officer.

2.16 EXHAUST HOODS OVER COOKING EQUIPMENT

Conform to NFPA 96 and UL 710. Conform to SMACNA HVAC Duct Const Stds. Provide seismic restraints in accord with SMACNA KEFG. The hood must not vary from design listing of air requirements or static pressure by more than five percent. Fabricate from 1.2 mm thick 18 gage stainless steel. Run electrical wiring in conduit or raceways. When total hood length is more than 3600 mm 12 feet long, provide hoods individually complete in all respects, of approximately equal length less than 3600 mm 12 feet long, and mounted end to end.

2.16.1 Hoods with face supply

Fabricate in factory. Hood shall be full compensating wall canopy with the capability to replace up to 95% of the exhausted air with fresh outside air. Air shall be supplied through perforated panels in a manner that does not interfere with the cooking operations beneath the hood. Perforated panels shall be located on the face to ensure precise volume control and shall limit the throw to within several feet of the hood.

The hood shall include a filter housing constructed of the same material as the hood. The filters shall be aluminum baffle type (stainless optional), U. L. Classified, and in sufficient number and sizes to ensure optimum performance. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container.

2.16.1.1 Types of Hoods

Provide the following hood types as indicated:

a. Wall-Mounted: Provide over ranges located along wall. Mount at height indicated.

2.16.1.2 Features

Provide the following:

a. Fan control.
b. Damper controls.
c. Fire protection system, for hoods over heavy duty ranges.
d. UL classified washable grease filters.
e. Vapor-proof lights.

2.16.1.3 Fan Control

Provide delay-time starter on starter leg of exhaust fan so supply fan starts first and run 5 seconds before exhaust fan starts, to insure the required balance in exhausted and make-up air flow. Provide the following operations:

a. Operation by manual push buttons labeled "start" and "stop".

2.16.1.4 Fire Damper

Provide mechanically driven damper and damper control. Activate by heat-sensing thermostat set to react to temperature of 176 degrees C 350 degrees F in exhaust duct at hood. Activation of damper must cause the following additional actions:

a. Shut off exhaust and supply fans of hood.
b. Shut off fuel source and electric power to equipment under hood.
c. Initiate automatic washdown system.

2.16.1.5 Fire Protection Systems

Provide a pre-engineered dry chemical system in accord with NFPA 96. Include micro-switch for electric power and fuel shut off to equipment under hood and a fuel shut-off and reset button. Exposed piping under hood and surface nozzles to be stainless steel or chrome plated. Paint exposed piping running

to hood with rust-inhibiting aluminum paint. Provide electrical wiring, contactors, shunt breakers, electrical control for gas valves, and other electrical components required to install fire systems in accord with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

a. Actuating Stations. Provide manual actuating station and remote manual actuating station as indicated. Clearly label actuating station as "Hood Fire Protection" and specific device protected.

b. Alarm Connection: Provide capability to signal operational readiness and to generate electronic signal when hood fire system is activated.

2.16.1.6 Vapor proof Lights

Provide incandescent or fluorescent lights in accord with UL 1598 or UL 1598. Locate switches for operating hood lights on face of hood in lower right corner.

2.17 LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 1.44 kilopascals. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500 and AMCA 511. The rating shall show a water penetration of 0.06 kilograms or less per square meter of free area at a free velocity of 244 meters. Finish shall be a factory-applied coating. Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer and baked enamel finish coat, 0.025 mm minimum total dry film thickness, color as directed by architect. Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations. Mount screens in removable, rewirable frames of same material and finish as the louvers. Provide zinc-coated or stainless steel screws and fasteners for louvers. Provide other accessories as required for complete and proper installation. Provide 12.5 mm square mesh, 1.5 mm thick zinc-coated steel or copper bird screening.

2.17.1 Bird Screens and Frames

Bird screens shall conform to ASTM E 2016, No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, and fabricated from either stainless steel or extruded aluminum.

2.17.2 Sand Trap Louver

Extruded aluminum frame and blades 1.5 mm and 1.2 mm thick, composed of two sets of inverted U - channels mounted vertically on two opposite rows. Channels shall be fixed with a removable volume control damper to ensure control of air stream. Louver shall be provided with 2 rows of 20 mm dia. self draining holes for emptying filtered sand and dust. Volume damper shall be low leakage, galvanized steel with extruded aluminum blades. Bird screen shall be 12 mm x 12 mm x 1.5 mm dia aluminum wire mesh. Aluminum filters with washable expanded aluminum media, 50 mm thickness, designed to separate and dust from the air stream.

2.18 ELECTRIC HEAT MAKE-UP AIR UNIT

Make up air units shall be self-contained packaged with a permanent washable) air filter, electric heating element, modulating element temperature control, and blower, designed specifically for outside air inlet. Heaters shall conform to the requirements of UL 1996. Units shall be factory prewired, ready for field terminal connections. Cabinet enclosure shall be galvanized insulated sheet metal sealed tight. Provide unit with finned rod modulating electric elements, high temperature limit switch, airflow proving switch and an outlet temperature sensing control. Unit shall include adjustable speed blower with PSC motor. Outside air inlet shall include a sand-trap type intake louver with washable pre filter. Include remote mounted thermostat with Auto, Fan and Heat modes. Unit shall be mounted tight to structure above with vibration isolators.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be as shown and according to the manufacturer's diagrams, recommendations and manufacturer's installation instructions.

3.1.1 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. . The depth of each seal shall be 50 mm plus 0.1 mm for each Pa, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting.

3.1.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports.

3.1.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS.

3.1.4 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is

provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.5 Kitchen Exhaust Ductwork

3.1.5.1 Ducts Conveying Smoke and Grease Laden Vapors

Ducts conveying smoke and grease laden vapors shall conform to requirements of NFPA 96. Seams, joints, penetrations, and duct-to-hood collar connections shall have a liquid tight continuous external weld. Duct material shall be minimum 1.3 mm, Type 304L or 316L, stainless steel Duct construction shall include external perimeter angle sized in accordance with SMACNA HVAC Duct Const Stds, except welded joint reinforcement shall be on maximum of 600 mm centers; continuously welded companion angle bolted flanged joints with flexible ceramic cloth gaskets where indicated; pitched to drain at low points; welded pipe coupling-plug drains at low points; welded fire protection and detergent cleaning penetration; steel framed, stud bolted, and flexible ceramic cloth gasketed cleaning access provisions where indicated. Angles, pipe couplings, frames, bolts, etc., shall be same material as that specified for the duct unless indicated otherwise.

3.1.5.2 Exposed Ductwork

Exposed ductwork shall be fabricated from minimum 1.3 mm, Type 304L or 316L, stainless steel with continuously welded joints and seams. Ducts shall be pitched to drain at hoods and low points indicated. Surface finish shall match hoods.

3.1.5.3 Concealed Ducts Conveying Moisture Laden Air

Concealed ducts conveying moisture laden air shall be fabricated from minimum 1.3 mm, Type 300 series, stainless steel Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated. Transitions to other metals shall be liquid tight, companion angle bolted and gasketed.

3.1.6 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.7 Insulation

Sheet metal ductwork shall be clean, dry and sealed tightly prior to insulating with Duct Wrap. To ensure installed thermal performance, Duct Wrap shall be cut to "stretch-out" dimensions. This requires measurement of the duct perimeter, then cutting the duct wrap to the dimension (perimeter + add-on) indicated in the manufactures' stretch-out chart. A 50mm piece of insulation shall be removed from the facing at the end of the piece of insulation to form an overlapping stapling and taping flap. The duct wrap is installed with the facing out. Adjacent sections of duct wrap shall be tightly butted with the 50mm stapling and taping flap overlapping. Seams

shall be stapled approximately 150mm o.c. with 13mm min. steel outward clinching staples. Seams shall be sealed with vapor retarder mastic or pressure-sensitive tape matching the insulation facing. Seal all tears, punctures, and/or other penetrations of the duct wrap facing with tape or mastic to provide a vapor-tight system.

3.1.8 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.9 Power Roof Ventilator Mounting

Foamed 13 mm thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.10 Exhaust Hoods Over Cooking Equipment Installation

Install in accordance with manufacturer's printed instructions.

3.1.11 Installation of Hoods

Install in accord with NFPA 96. Install hoods to remain free from vibration under all conditions of operation.

Upon completion perform operational tests on each piece of equipment to determine that equipment and components, including controls, safety devices, and attachments, operate as specified and are properly installed and adjusted. Notify the Contracting Officer 14 calendar days prior to testing. Submit 6 copies of the Exhaust Hood Air-Balance Report to the Contracting Officer.

3.2 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Provide sleeves for round duct 380 mm and smaller. Provide framed prepared openings for round duct larger than 380 mm and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide 25 mm clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C 553, Type 1, Class B-2.

a. Sleeves: Fabricate sleeves, except as otherwise specified or indicated, from 1 mm thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A 53/A 53M, Schedule 20.

b. Framed Prepared Openings: Fabricate framed prepared openings from 1 mm galvanized steel, unless otherwise indicated.

c. Insulation: Provide duct insulation in accordance with Article 2.17 continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 16 degrees C, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

d. Closure Collars: Provide closure collars of a minimum 100 mm wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 380 mm in diameter or less from 1 mm galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 380 mm from 1.40 mm galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 380 mm or less from 1 mm galvanized steel. Install collars with fasteners a maximum of 150 mm on center. Attach to collars a minimum of 4 fasteners where the opening is 300 mm in diameter or less, and a minimum of 8 fasteners where the opening is 500 mm in diameter or less.

e. Firestopping: Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.3 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, filters, etc. Test procedure, apparatus, and report shall conform to SMACNA Leakage Test Mnl. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior.

3.4 DAMPER ACCEPTANCE TEST

Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.5 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93.00 10 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.6 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Make corrections and adjustments as necessary to produce the

conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 10 days for each system and shall demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

3.7 CLEANING AND ADJUSTING

Inside of ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions.

3.8 OPERATION AND MAINTENANCE TRAINING

The Contractor shall conduct a training course for the members of the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 16 hours of normal working time and shall start after all work specified herein is functionally completed and the Performance Tests have been approved. The field instruction shall cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Notify the Contracting Officer at least 14 days prior to the date of proposed conduct of the training course.

-- End of Section --

SECTION 23 05 93.00 10

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES	(2005) Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems

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

SMACNA HVACTAB	(2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing

1.2 SUBMITTALS

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

SD-01 Testing Adjusting and Balancing Submittals (TAB); GA

The contractor shall provide the following; GA
1) Two copies of the TAB Schematic Drawings and Report Forms, no later than 7 days prior to the start of the TAB field.
2) A list of TAB related HVAC submittals no later than seven days prior to the start TAB field measurments.
3) Proposed procedures for TAB, submitted with the TAB schematic drawings and report forms.
4) Proposed date and time to begin the systems readiness check, no later than seven days prior to the start of the system readiness check.
5) Proposed date and time to begin field measurement, making adjustments, etc., for the TAB report, submitted with the TAB report.
6) Proposed date and time to begin the TAB verification, submitted with the TAB report.

7) A copy of completed checklists for each system in the contract scope, each signed by the contractor's representative, at least seven days prior to the start of TAB execution.
8) Two copies of the completed TAB reports, no later than seven days after the execution of TAB signed by the contractors representative.

SD-07 Certificates

Ductwork Leak Testing; FIO

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

TAB Firm; GA

Certification of the proposed TAB Firm's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than (21) days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC, NEBB or TABB against the proposed TAB Firm shall be described in detail.

TAB Specialist; GA

Certification of the proposed TAB Specialist's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than (21) days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC, NEBB, or TABB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.	SMACNA's Procedures

TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.	Field Readiness Check & Prelim. Field Procedures

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including building systems commissioning. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of the mechanical subcontractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The

measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --

SECTION 23 11 13.00 20

FUEL OIL PIPING
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1110	(1997) Pressure Testing of Liquid Petroleum Pipelines
API Std 599	(2002) Metal Plug Valves - Flanged, Threaded and Welding Ends
API Std 600	(2001; R 2006) Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding
AWS Z49.1	(2005) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME A13.1	(1996; R 2002) Scheme for the Identification of Piping Systems
ASME B1.1	(2003) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.24	(2001) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.39	(1998) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B16.9	(2003) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)
ASME B18.52.1	(1996; R 2005) Square and Hex Bolts and Screws Inch Series
ASME B31.1	(2004; Addenda 2005) Power Piping
ASME B31.3	(2004) Process Piping
ASME B31.4	(2006) Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquid
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 194/A 194M	(2006a Standard Specification for) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-72	(1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2003; Errata 2004; Errata 2006) Flammable and Combustible Liquids Code
NFPA 31	(2006; Errata 2006) Installation of Oil Burning Equipment
NFPA 70	(2005; TIA 2005) National Electrical Code

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

SMACNA Seismic Restraint Mnl	(1998; Addendum 2000, 2nd Ed) Seismic Restraint Manual: Guidelines for Mechanical Systems

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002; E 2004) Paint Specification No. 20 Zinc-Rich Coating Type I Inorganic and Type II Organic
SSPC SP 10	(2000; E 2004) Near-White Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	(Rev B; Notice 1) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-P-24441	(Rev C; Supp 1; Am 1) Paint, Epoxy-Polyamide
MIL-PRF-24176	(Rev C) Cement, Epoxy, Metal Repair and Hull moothing (Metric)
MIL-PRF-4556	(Rev F; Am 1) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-PRF-907	(Rev F) Antiseize Thread Compound, High Temperature

MIL-V-18436	(Rev F) Valves, Check, Bronze, Cast Iron, and Steel Body

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-1689	(Rev B) Tape, Pressure-Sensitive Adhesive, (Plastic Film)
FS A-A-50568	(Basic) Gages, Liquid Level Measuring, Tank
FS A-A-58092	(Basic) Tape, Antiseize, Polytetrafluoroethylene
FS A-A-59313	(Basic; Notice 1) Thread, Compound, Antiseize, Zinc Dust-Petrolatum
FS F-C-2916	(Basic) Caps, Vent, Fuel Storage Tank
FS L-C-530	(Rev C) Coating, Pipe, Thermoplastic Resin
FS L-T-1512	(Rev A) Tape, Pressure Sensitive Adhesive, Pipe Wrapping
FS WW-S-2739	(Basic) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

UNDERWRITERS LABORATORIES (UL)

UL 142	(2006) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 842	(1997; Rev thru Aug 2005) Standard for Valves for Flammable Fluids
UL Gas&Oil Dir	(2006) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 DEFINITIONS

1.2.1 Carrier Piping

Piping which contains diesel fuel or MOGAS, exclusively.

1.2.2 Secondary Containment System

System which contains carrier piping and prevents fuel leakage from carrier piping into surrounding soil and/or water. System to be double-walled piping.

1.3 SUBMITTALS

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

SD-02 Shop Drawings; GA

Diesel Fuel Storage Tanks

SD-03 Product and Catalog Data; GA

Pipe and fittings

Valves

Flexible hose

Dielectric unions

Strainers

Instruments

Secondary containment system for piping

SD-06 Testing of Fuel Oil Tanks and Fuel Oil Pumps Including Instrumentation and Fuel Oil Piping Including Prefabricated Joints; GA

The contractor shall provide the following: Six copies of each test containing the information described below (items 1-7) in bound letter-size booklets; individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible. 1) The date the tests were performed. 2) A list of equipment used, with calibration certifications. 3) A copy of measurements taken. 4) The parameters to be verified. 5) The condition specified for the parameter. 6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance the plans and specifications. 7) A description of adjustments performed.

SD-07 Certificates; GA

Welding procedure

Qualification of welders

List of welder's names and symbols

Flexible hose

Dielectric unions

Tank surface preparation

Coating materials

Coating application procedure

SD-08 Manufacturer's Instructions

Secondary containment system for piping

Flexible pipe

SD-10 Installation, Operation and Maintenance Manuals

Diesel Fuel Tank

Submit Data Package 3 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Welding Procedure

Before performing welding, submit three copies of welding procedure specification for metals included in the work, together with proof of its qualifications as outlined in ASME B31.1.

1.4.2 Qualification of Welders

Before welder or operator performs welding, submit to the Contracting Officer three copies of the Welder's Performance Qualification Record in conformance with ASME B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor.

1.4.3 List of Welder's Names and Symbols

Submit each welder's assigned number, letter, or symbol which shall be used to identify the work of the welder and shall be affixed immediately upon completion of the weld.

1.4.4 Defective Welds

Welders making defective welds after passing a qualification test shall be required to take a re-qualification test. Welders failing the re-qualification tests will not be permitted to work under this contract.

1.4.5 Previous Welder Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without re-qualification, subject to approval by the Contracting Officer provided that all the conditions specified in ASME B31.1 are met before a procedure can be used.

1.5 WELDING SAFETY

AWS Z49.1.

1.6 REGISTRATION

Contractor shall obtain required tank registration or permit/approval application forms from governing regulatory agencies. Furnish completed forms to the Contracting Officer and the installation environmental office within 10 days after contract award for their submission to the regulatory agency.

PART 2 PRODUCTS

Fuel oil system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, NFPA 70 and SMACNA Seismic Restraint Mnl, as modified and supplemented by the contract specifications and drawings.

2.1 MATERIALS AND EQUIPMENT

2.1.1 Steel Pipe and Fittings

2.1.1.1 Secondary Containment System for Piping

Provide double-walled steel secondary containment piping for diesel fuel and MOGAS piping systems. Secondary containment piping systems shall be an engineered and prefabricated double pipe type containment system. Carrier pipe shall be standard weight carbon steel, ASTM A-53, Grade B, ERW or seamless. Joints shall be socket or buttweld. Secondary containment pipe shall be carbon steel ASTM A-139, Grade B, ASTM A-135, Grade B or ASTM A-53, Grade B. Thickness for pipe diameters under 125 mm shall be schedule 40. Provide a fiberglass reinforced polyester external cladding to outer pipe for corrosion resistance. Secondary containment shall allow for complete inspection of carrier pipe connections, during carrier pipe hydrostatic testing, before the secondary containment system is sealed. The secondary containment system shall be:

a. Compatible with diesel fuel and MOGAS fuel.

b. Non-corrosive, di-electric, non-degradable and resistant to attack from microbial growth.

2.1.1.2 Socket-Welding Fittings

ASME B16.11, forged steel, Class 2000.

2.1.1.3 Butt-Welding Fittings

ASME B16.9, Class 150. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2.1.1.4 Flanges and Flange Fittings

ASME B16.5, steel flanges or convoluted steel flanges which meet the criteria of ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2.1.2 Flexible Pipe

2.1.2.1 Pipe

Flexible pipe shall be approved by the Underwriters Laboratories for the service intended and listed in UL Gas&Oil Dir. Use of flexible piping is limited to connection at generator only and at pressures not exceeding that marked on the pipe.

2.1.2.2 Flexible Pipe Fittings

Bronze mechanical coupling shall be supplied by the same manufacturer as the pipe.

2.1.3 Vent Piping

ASTM A 53/A 53M standard weight, zinc-coated steel with zinc-coated malleable iron fittings ASME B16.3.

2.1.4 Valves

2.1.4.1 Bronze Gate Valves

MSS SP-80 Class 125, 50 mm and smaller, wedge disk, nonrising stem.

2.1.4.2 Steel Gate Valves

API Std 600, oil service, Class 150.

2.1.4.3 Ball Valves

MSS SP-72 for flanged or butt-welding ends and MSS SP-110 for socket-welding.

2.1.4.4 Relief Valves

UL 842, steel or bronze bodies, corrosion-resistant valve seats, and positive closing to prevent leakage.

2.1.4.5 Check Valves

Metal body, Class 200, suited for use in diesel fuel and gasoline applications.

2.1.5 Piping Accessories

2.1.5.1 Flexible Hose

Flexible metal hose, corrugated type with braided wire sheath covering, close-pitch annular corrugations, rated for a working pressure of at least 862 kPa (gage), 200 mm minimum live length, screwed end connections, UL listed for flammable liquid service. Metal for hose and braided wire sheath shall be stainless steel, any type of ASTM 300-series.

2.1.5.2 Unions

ASME B16.39, Class 150 pound.

a. Dielectric Unions: Union comprised of steel female pipe thread end and copper solder-joint end conforming to dimensional, strength, and pressure requirements of ASME B16.39, Class 1. Steel parts shall be galvanized or plated. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, it shall be able to withstand a 600-volt breakdown test.

2.1.5.3 Welding Filler Metal

ASME B31.4 and compatible with the materials to be welded.

2.1.5.4 Brazing Filler Metal

AWS A5.8/A5.8M, silver base alloy, with melting point not less than 593 degrees C.

2.1.5.5 Hangers, Supports, and Shields

Design, selection, fabrication, installation, and spacing shall conform to MSS SP-58 and MSS SP-69. Hangers, supports, rods, anchors, nuts, bolts, and washers shall be hot-dip galvanized. Hangers and supports shall be of the adjustable type.

2.1.5.6 Strainers

FS WW-S-2739 single basket type, with inlet and outlet on the same center line. Cast steel or fabricated steel body, 40 by 40 mesh ASTM 300-series stainless steel baskets. Open area of one basket shall be 2 1/2-times inlet or outlet piping area. Furnish one spare basket.

2.1.5.7 Gaskets

Provide one piece, factory cut, 1.60 mm thick, gaskets resistant to the effects of fuel oil and manufactured of fire-resistant materials. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints. Dimensions for gaskets shall be in accordance with ASME B16.21.

2.1.5.8 Bolting

Material for bolts and studs ASTM A 307, Grade-B and for nuts ASTM A 194/A 194M, Grade-2. Dimensions of bolts, studs and nuts ASME B18.52.1 and ASME B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

2.1.5.9 Sleeves in Stone,Masonry and Concrete Walls, Floors,

Provide ASTM A 53/A 53M, Schedule 40 or Standard Weight, zinc-coated steel pipe sleeves.

2.1.5.10 Sleeves in Other Wall, and Floor Materials

Provide minimum 26 gage zinc-coated steel sheet sleeves in partitions and other than masonry and concrete walls, floors, and roof.

2.1.5.11 Floor, Walls, and Ceiling Plates

Plates shall be painted cast-iron, malleable iron, or steel.

2.1.5.12 Identification for Piping Aboveground

Labels for pipes 20 mm diameter and larger shall bear printed legends to identify contents of pipes and arrows to show direction of flow. Labels shall have color coded background to signify levels of hazard in accordance

with ASME A13.1. Legends and type and size of characters shall also conform to ASME A13.1. Make labels of plastic sheet FS A-A-1689 with pressure sensitivity suitable for intended applications, or they may be premolded of plastic to fit over pipe. For pipes smaller than 20 mm diameter, provide brass identification tags 40 mm in diameter with legends in depressed black filled characters.

2.1.5.13 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural shapes, hot-dip galvanized after fabrication.

2.1.6 Instruments

2.1.6.1 Tank Gages

FS A-A-50568, buoyant force type with direct reading dial.

2.1.6.2 Thermometers

Thermometers shall be bi-metal dial type with stainless steel case, stem, and fixed thread connection; 125 mm diameter dial with glass face gasketed within the case; accuracy within one percent of scale range. Provide scale range suitable for the intended service.

2.1.6.3 Pressure Gages

ASME B40.100, single style with 115 mm diameter dial for fuel, brass or aluminum case, bronze tube; accuracy within 2 percent of scale range. Provide scale range suitable for the intended service.

2.1.7 Protective Coating Materials for Aboveground Pipe and Tanks

Coatings shall be the products of one manufacturer and coating application procedure shall be in accordance with manufacturer's instruction. Tank surface preparation shall be abrasive blast clean steel surfaces in accordance with SSPC SP 10 to a surface profile of 0.013 to 0.051 mm.

2.1.7.1 External Coatings

Protect aboveground piping and steel tanks against atmospheric corrosion with a coat of organic, lead and chromate free, zinc-rich primer conforming to SSPC Paint 20, Type II applied to a minimum dry film thickness of 0.102 mm and finish with two coats of epoxy-polyamide topcoat conforming to MIL-P-24441. Apply a gray first topcoat conforming to MIL-P-24441/2, Formula 151 applied to a minimum dry film thickness of 0.076 mm and finish with a white second topcoat conforming to MIL-P-24441/3, Formula 152 applied to a minimum dry film thickness of 0.076 mm resulting in a total system minimum dry film thickness of 0.28 mm.

PART 3 EXECUTION

3.1 INSTALLATION

Contractor shall provide installation of fuel oil piping system in accordance with applicable Federal, State, regional or local regulations.

3.1.1 Fuel Oil Piping System

Install piping in out-of-the-way locations, in a manner that will minimize cutting of beams, girders, columns, or load-bearing members. Installation of oil piping and equipment in buildings shall conform to NFPA 30 and NFPA 31, except as indicated or specified herein.

3.1.2 Pipe Sleeves and Plates

Provide sleeves where piping passes through walls, floors, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and partitions. Extend sleeves in floor slabs 80 mm above the finished floor. Provide not less than 6 mm space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Secure plates to pipes at sleeves.

3.1.3 Steel Piping

Steel piping 50 mm and smaller shall be threaded or socket-welded. Steel piping 65 mm and larger shall be buttwelded. Flanges may be used for valves and equipment installation. Piping joints shall conform to ASME B31.3.

3.1.4 Threaded Joints in Piping

Provide lubricant or polytetrafluoroethylene tape conforming to FS A-A-58092 on male threads of screwed joints. Red or white lead and zinc compound conforming to FS A-A-59313 may be used. Lubricate threaded pipe joints, as well as bolts and studs used on high temperature pipe joints up to 566 degrees C, with anti-seize compound in accordance with MIL-PRF-907. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore and remove chips. Attach screwed flanges by screwing the pipe through the flange, and reface pipe and flange accurately.

3.1.5 Welding

3.1.5.1 Welding of Piping

Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards specified in Chapter VI of ASME B31.1.

3.1.5.2 Quality of Welds

Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.

3.1.5.3 Arc Welding and Gas Welding

In accordance with ASME BPVC SEC IX.

3.1.6 Unions and Flanges

Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

3.1.7 Valves

Install valves in positions accessible for operation and repair.

3.1.8 Thermometers

Provide thermometers and thermal sensing elements of control valves with separable sockets. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing fluid and minimize obstruction to flow.

3.1.9 Diesel Fuel Storage Tanks

Install storage tanks, vents and other connections in accordance with NFPA 30, NFPA 31, recommendations and published instructions of the manufacturer, and as indicated. Provide grounding of tanks directly through ground rods or through bonding to grounded network in accordance with NFPA 780. Fasten aboveground fuel oil tanks on a firm reinforced concrete foundation. Provide fireproofed steel supports between tank and foundation. Concrete shall have a compressive strength of 2.8 kPa, 20 mm<ENG> [3/4] inch</ENG> maximum aggregate size and 80 to 100 mm slump. Materials for sand, gravel, and concrete shall meet requirements specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

3.2 FIELD QUALITY CONTROL

Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated test gage in the system. Maintain test pressure for at least one hour. In the event of leakage, locate and repair leak by rewelding and repeat test. Materials and equipment shall be subject to inspection at the installation site by the Contracting Officer.

3.2.1 Piping Test

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Furnish electricity, instruments, connecting devices, and personnel for the tests. Correct defects in work provided by the Contractor and repeat tests until work is in compliance with contract requirements. Government will furnish fuel for piping testing and flushing provided by the Contractor. Contractor shall be responsible for test fuel losses greater than 10 percent.

3.2.1.1 Pneumatic Test

Pneumatically test each piping system to 172 kPa (gage), examine joints with soap solution. Gradually increase to 345 kPa (gage) and hold for 1 hour. The pneumatic test is more hazardous than a hydrostatic test, therefore, special safety measures, including the wearing of face masks, shall be taken during testing under pressure. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing.

3.2.1.2 Hydrostatic Tests

Upon completion of pneumatic testing, hydrostatically test each piping system at 1.5 times maximum system operating pressure but in no case more than 1896 kPa (gage) in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gage pressure for 4 hours.

3.2.1.3 Flushing

Thoroughly flush piping before placing in operation. Flush piping, including branch piping, at a minimum velocity of 2.40 meters per second.

3.2.2 Secondary Containment Piping Test

The secondary containment piping system shall undergo a 34 kPa minimum air-pressure/soap test upon completion of installation to confirm the secondary containment integrity. This testing shall be in compliance with the manufacturer's published installation instructions.

3.2.3 Protective Coating Systems

Inspect protective coating systems, with a holiday tester just prior to placement. Holidays revealed shall be promptly repaired. Steel piping coating system shall be given a holiday test with a voltage of 100 to 200 times the mm thickness of the coating.

3.2.4 Steel Fuel Oil Storage Tanks

Test tanks for leaks by applying internal air pressure and using soapsuds, linseed oil or equivalent material on external welds. For horizontal tanks, test pressure shall be not less than 34 nor more than 48 kPa (gage). For vertical tanks, test pressure shall be not less than 10 kPa (gage) nor more than that pressure which first causes visible deformation of the tank. During testing, tank shall be provided with a suitable pressure relief device.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 709	(2001) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 13, SPECIAL CONSTRUCTION, and Divisions 22, 23, 27 and 28, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING COMMUNITCATIONS AND ELECTRICAL SAFETY. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 51 00 INTERIOR LIGHTING

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and

equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 220/380 volts, three phase, four wire, 50 Hz.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be

melamine plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 9 meters apart.
-- End of Section --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2005e13) Manual of Steel Construction

ASTM INTERNATIONAL (ASTM)

ASTM E 580	(2002e1) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-03A	(2005) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598	(2004; Rev thru May 2006) Luminaires

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Lighting Fixtures in Buildings
Equipment Requirements

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G
Equipment Requirements; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Light Fixtures
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	

1.3.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

1.3.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with UFC 3-310-03A and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-03A uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-03A are based on strength design; therefore, AISC 325 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor.

1.3.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 64 mm trade size. All other interior conduit, shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

The following specific items of equipment are to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-03A, Chapter 10. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Transformers
Switch Boards

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of UFC 3-310-03A, Chapter 10.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with ASTM E580. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-03A, Chapter 10. Recessed lighting fixtures not over 25 kg in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with ASTM E580. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-03A, Chapter 10.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 100 mm boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANIOUS EQUIPMENT.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
07/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(2001) Standard Specification for Hard-Drawn Copper Wire

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) Normal Measurements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C80.1	(2005) Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA C80.3	(2005) Standard for Electrical Metallic Tubing (EMT)
NEMA FU 1	(2002) Low Voltage Cartridge Fuses
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA KS 1	(2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(2006) Standard for Motors and Generators
NEMA MG 11	(1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors

NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2005) Standard for General Requirements for Wiring Devices
NEMA WD 6	(2002) Standard for Wiring Devices - Dimensional Requirements
NEMA Z535.4	(2002) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 70E	(2004; AMD 2004) Electrical Safety in the Workplace
NFPA 780	(2004) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005) Standard for Flexible Metal Conduit
UL 1242	(2006; Rev thru Jun 2006) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1660	(2004; Rev thru Jan 2005) Liquid-Tight Flexible Nonmetallic Conduit
UL 1699	(1999; Rev thru May 2003) Arc-Fault Circuit-Interrupters
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 20	(2004) Standard for General-Use Snap Switches
UL 2043	(1996; Rev thru Jun 2001) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 360	(2003) Liquid-Tight Flexible Steel Conduit
UL 44	(2005; Rev thru Nov 2005) Thermoset-Insulated Wires and Cables
UL 467	(2004) Standard for Grounding and Bonding Equipment

UL 486A-486B	(2003; Rev thru Aug 2006) Standard for Wire Connectors
UL 486C	(2004; Rev thru Aug 2006) Standard for Splicing Wire Connectors
UL 489	(2004; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2001; Rev thru Mar 2006) Attachment Plugs and Receptacles
UL 50	(2003; R 2005) Standard for Enclosures for Electrical Equipment
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(2005) Standard for Metallic Outlet Boxes
UL 514B	(2004; Rev thru Apr 2006) Standard for Conduit, Tubing and Cable Fittings
UL 6	(2004e13) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005e7) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 67	(1993; Rev thru Apr 2006) Standard for Panelboards
UL 6A	(2000; Rev thru Jan 2004) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 797	(2004) Standard for Electrical Metallic Tubing -- Steel
UL 817	(2001; Rev thru May 2005) Cord Sets and Power-Supply Cords
UL 83	(2003; Rev thru Apr 2006) Standard for Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Rev thru Nov 2005) Service-Entrance Cables
UL 869A	(2006) Reference Standard for Service Equipment
UL 870	(1995; Rev thru Jul 2003) Wireways, Auxiliary Gutters, and Associated Fittings

UL 886	(1994; Rev thru Nov 2005) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(2006) Ground-Fault Circuit-Interrupters
UL 984	(1996; Rev thru Sept 2005) Hermetic Refrigerant Motor-Compressors

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Panelboards; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Wireways; G

Marking strips drawings; G

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Enclosed circuit breakers; G

Motor controllers; G

Combination motor controllers; G

Manual motor starters; G

Telecommunications Grounding Busbar; G

Surge protective devices; G

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

Ground-fault receptacle test; G

SD-07 Certificates

Fuses; G

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.2 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.3 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, NEMA C80.3.

2.2.4 Flexible Metal Conduit

UL 1.

2.2.4.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.5 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.5.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.5.2 Fittings for EMT

Steel compression type.

2.2.6 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.7 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.2.8 Fittings for CFNC

UL 514B

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal.

2.3.1 Outlet Boxes for Telecommunications System

Provide standard type 100 mm square by 54 mm deep. Depth of boxes shall be large enough to allow manufacturers' recommended conductor bend radii.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 1640 mL, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. $8MM^2$ and larger diameter shall be stranded. Conductors No. $6MM^2$ and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. $4MM^2$; for Class 1 remote-control and signal circuits, No. $2.5MM^2$; for Class 2 low-energy, remote-control and signal circuits, No. $1.5MM^2$; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. $.5MM^2$.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 380/220 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 220 volt, single phase: Black and red

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. $10MM^2$ and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. $16MM^2$ and larger diameter.

2.5.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. $6MM^2$ and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges.

Plates on finished walls shall be nylon or lexan, minimum 0.792 mm wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be brown thermoplastic. Wiring terminals shall be screw-type, side-wired. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 220 volts, with current rating and number of poles indicated.

2.8.2 Breakers Used as Switches

For 220-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.8.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1, 3R enclosure as indicated per NEMA ICS 6.

2.9 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.9.1 Fuseholders

Provide in accordance with UL 512.

2.9.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-1 RK-5 time-delay type. Associated fuseholders shall be Class R only.

2.9.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.9.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 198H, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.10 SOCKET

Socket shall be British Standard and shall conform to BS 546:1950. Socket outlet shall be patented 3 pin safety shutter mechanism 15 amp 250 volt. Install in a flush back box minimum 35 mm deep. Provide with 89x89 mm silver satin finish cover plate. Sockets shall be ASTA certified.

2.10.1 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.10.2 Ground-Fault Socket

Provide a RCD socket 13A, 250 volts conforming to BS-7288:1990 and BS 1363 Part 2: 1995. Socket shall have earth pin release shutter with test and reset button. Socket shall have mechanical latching that does not trip on power failure (Passive) RCD unit 2 gang OP 30 MA. Flush box shall be a minimum of 25 MM deep. Cover plate shall be stainless steel 86x146 MM.

2.10.3 Special Purpose Receptacles

Special Purpose Receptacles will be specified on plans. Furnish one matching plug with each receptacle.

2.11 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated of 10,000 amperes symmetrical minimum. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped unless indicated otherwise. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboard shall have nameplates in accordance with paragraph FIELD FABRICATED NAMEPLATES.

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required

by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering. Panelboard shall have nameplates in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.11.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than 3.5 millimeters if flush-mounted or mounted outdoors, and not less than 2.7 millimeters if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R raintight with conduit hubs welded to the cabinet. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 3 millimeters. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 millimeter clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 600 millimeters long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets.

2.11.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.11.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Provide earth leakage circuit breakers, three pole for 2 and 3 wire circuits and four pole for 3 phase circuits.

2.11.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.3.2 Circuit Breaker With GFI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFI devices, for personnel protection

2.11.3.3 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.12 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.13 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs); shall conform to UL 508 and UL 489 and shall be provided as shown. MSCPs shall consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. MSCPs shall be rated in accordance with the requirements of NFPA 70.

2.14 MOTORS

NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of kW, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 380-volt, 3-phase circuits shall have terminal voltage rating of 380 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 745 Watts (1 HP) and above shall be continuous duty type.

Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.14.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.14.2 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under

most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.14.3 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.15 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram.For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes. Provide controllers in hazardous locations with classifications as indicated.

2.15.1 Control Wiring

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards.

Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. $6MM^2$. The minimum size of control wire shall be No. $2.5MM^2$. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. $4MM^2$. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.15.2 Control Circuit Terminal Blocks

NEMA ICS 4. Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. $6MM^2$ in size and shall have sufficient length and space for connecting at least two indented terminals for $6MM^2$ conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.15.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.15.3 Control Circuits

Control circuits shall have maximum voltage of 220 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side.

Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.

2.15.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.15.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.15.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.15.7 Pilot and Indicating Lights

Provide LED cluster lamps.

2.15.8 Reduced-Voltage Controllers

Reduced-voltage starters shall be single-step, closed transition solid state-type, or as indicated, and shall have adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of centrifugally operated equipment.

2.16 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single Double Three pole designed for flush surface mounting with overload protection and pilot lights.

2.16.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color shall be green, red, amber in accordance with NEMA ICS 2.

2.17 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, Heating Ventilation and Air Conditioning"; Division 22, "Plumbing"; and Division 33."

2.17.1 Other Equipment-Ceiling Fans

Wobble-free canopy,52" blade span (except for models with feather blades (54"), min. 188 mm x 15 mm diameter motor, 14° (degree) blade pitch for maximum air flow, 3 speeds (high, medium, low), reversible air flow whisper-

quiet operation (no hum), top quality finishes and plating, wall-mounted switch.

2.18 GROUNDING AND BONDING EQUIPMENT

2.18.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 19 mm and minimum length of 3050 mm.

2.18.2 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated.

2.19 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.20 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

2.21 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING .

2.22 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Dark Gray. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 6.35 mm in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 21 mm in diameter for low voltage lighting and power circuits. Metal conduit shall extend through shafts for minimum distance of 150 mm. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped in accordance with Section 07 84 00, FIRESTOPPING.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 890-N (200-pound) force tensile strength. Leave minimum 915 mm of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 150 mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members

where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

3.1.4.2 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(4) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

3.1.4.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS.

3.1.4.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 75 mm of concrete and shall be installed minimum 460 mm below slab or grade.

3.1.4.5 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 305 mm below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.6 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.7 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; or PVC, Type EPC-40, e unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum 25 mm cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than 27 mm trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab.

3.1.4.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 150 mm above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.9 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 40 mm in reinforced concrete beams or to depth of more than 20 mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 63 mm inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.10 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.11 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.12 Flexible Connections

Provide flexible steel conduit between 915 and 1830 mm in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 16 mm diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 2135 mm above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 100 mm square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel or nail-type. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 610 mm from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 40 mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 100 mm square, except that 100 by 50 mm boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 120 mm square by 54 mm deep. Mount outlet boxes flush in finished walls.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 1980 mm above floor. Mount receptacles and telecommunications outlets 460 mm above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets shall be mounted at height 1525 mm above finished floor. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 16MM^2 and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 25MM^2 and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations

3.1.7.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 6MM^2 and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 10MM^2 and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 0.58 mm. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00, FIRESTOPPING.

3.1.11 Grounding and Bonding

Provide In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system.

3.1.11.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 1830 mm on centers. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.11.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.11.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Government-Furnished Equipment

Contractor shall rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.14 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00, PAINTS AND COATINGS.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. $16MM^2$and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 28 01.00 10

COORDINATED POWER SYSTEM PROTECTION
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE C37.13	(1990; R 2005) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2000) Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors, - Preferred Ratings, Related Requirements, and Application
IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contact Designations
IEEE C37.20.1	(2002) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE Std 242	(2001) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE Std 399	(1997) Recommended Practice for Power Systems Analysis - Brown Book

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA C37.50	(1989; R 2000) Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
NEMA FU 1	(2002) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005) Standard for Industrial Control and Systems General Requirements

NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(2006) Standard for Industrial Controls and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 486E	(1994; Rev thru May 2000) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(2004; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 508	(2005) Standard for Industrial Control Equipment

1.2 SUBMITTALS

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

SD-03 Product Data

Fault Current Analysis
Protective Device Coordination Study

The study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for

installation of equipment or devices ordered and/or procured prior to approval of the study.

Equipment

Data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

System Coordinator

Verification of experience and license number, of a registered Professional Engineer with at least 3 years of current experience in the design of coordinated power system protection. Experience data shall include at least five references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers. This engineer must perform items required by this section to be performed by a registered Professional Engineer.

Protective Relays

Data shall including calibration and testing procedures and instructions pertaining to the frequency of calibration, inspection, adjustment, cleaning, and lubrication.

Installation

Procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Field Testing

The proposed test plan, prior to field tests. Plan shall consist of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault protection equipment, where used. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Devices and Equipment

Certificates certifying that all devices or equipment meet the requirements of the contract documents.

1.3 SYSTEM DESCRIPTION

The power system covered by this specification consists of: The installation of the complete electrical interior distribution system .

1.4 QUALIFICATIONS

1.4.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems.

1.4.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years of current product experience in protective devices.

1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

1.6 PROJECT/SITE CONDITIONS

Devices and equipment furnished under this section shall be suitable for the following site conditions. Seismic details shall conform to Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

1.6.1 Altitude

Altitude: As determined by site location.

1.6.2 Ambient Temperature

Ambient Temperature: +50 degrees C -30 degrees C.

1.6.3 Frequency

Frequency: 50 HZ.

1.6.4 Seismic Parameters

Seismic Parameters: As determined by site conditions.

1.7 EXTRA MATERIALS

The following spare fuses or spare fuse elements shall be delivered to the Contracting officer when the electrical system is accepted:

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Protective devices and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall

essentially duplicate items that have been in satisfactory utility type use for at least two years prior to bid opening.

2.2 NAMEPLATES

Nameplates shall be provided to identify all protective devices and equipment. Nameplate information shall be in accordance with NEMA AB 1 or NEMA SG 6 as applicable.

2.3 CORROSION PROTECTION

Metallic materials shall be protected against corrosion. Ferrous metal hardware shall be zinc or chrome-plated.

2.4 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.4.1 Motor Starters

Combination starters shall be provided with circuit breakers or fusible switches.

2.4.2 Thermal-Overload Protection

Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.4.3 Low-Voltage Motor Overload Relays

2.4.3.1 General

Thermal and magnetic current overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 second. Slow units shall be used for motor starting times from 8 to 12 seconds. Quick trip units shall be used on hermetically sealed, submersible pumps, and similar motors.

2.4.3.2 Construction

Manual reset type thermal relays shall be bimetallic construction. Automatic reset type relays shall be bimetallic construction.

2.4.3.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise,

and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 10 degrees C, an ambient temperature-compensated overload relay shall be provided.

2.4.4 Automatic Control Devices

2.4.4.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate kilowatt rating.

2.4.4.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.4.4.3 Manual/Automatic Selection

a. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

b. Connections to the selector switch shall only allow the normal automatic regulatory control devices to be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the contracting Officer unless such diagram is included on the drawings. All controls shall be 220 volts or less unless otherwise indicated.

2.5 LOW-VOLTAGE FUSES

2.5.1 General

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as specified. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics requires for effective power system coordination.

2.5.2 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. Class H Fuses shall conform to UL 198B. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds. Cartridge fuses shall be used for circuits rated in excess of 30 amperes, 220 volts, except where current-limiting fuses are indicated.

2.5.3 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class G, J, K, L, RK1, RK5, RK9, T, CC shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject Class H fuses.

a. Class G, J, L, CC fuses shall conform to UL 198C.

b. Class K fuses shall conform to UL 198D.

c. Class R fuses shall conform to UL 198E.

d. Class T fuses shall conform to UL 198H.

2.5.3.1 Continuous Current Ratings (600 amperes and smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, RK5, J, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.5.3.2 Continuous Current Ratings (greater than 600 amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.5.3.3 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.6 MOLDED-CASE CIRCUIT BREAKERS

2.6.1 General

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, or combination motor controllers. Circuit breakers and circuit breaker enclosures located in hazardous (classified) areas shall conform to UL 877.

2.6.2 Construction

Molded-case circuit breakers shall be assembled as an integral unit in a supporting and enclosing housing of glass reinforced insulating material providing high dielectric strength. Circuit breakers shall be suitable for mounting and operating in any position. Lugs shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers

shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.6.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.6.4 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.6.5 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.6.6 SWD Circuit Breakers

Circuit breakers rated 15 amperes or 20 amperes and intended to switch 220 volts or less fluorescent lighting loads shall be marked "SWD."

2.6.7 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 380 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.6.8 Motor Circuit Protectors (MCP)

Motor circuit protectors shall conform to NEMA AB 1 and UL 489 and shall be provided as shown. MCPs shall consist of an adjustable instantaneous trip

circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short-circuit protection. Motor Circuit Protectors shall be rated in accordance with NFPA 70.

2.7 LOW-VOLTAGE POWER CIRCUIT BREAKERS

2.7.1 Construction

Low-voltage power circuit breakers shall conform to IEEE C37.13, IEEE C37.16, and NEMA SG 6 and shall be three-pole, single-throw, stored energy, manually operated. Circuit breakers shall have an open/close contact position indicator, charged/discharged stored energy indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of the primary disconnects when the circuit breaker is closed. Control voltage shall be 220 V ac. The circuit breaker enclosure shall be suitable for its intended location.

2.7.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings shall be in accordance with IEEE C37.16. Tripping features shall be as follows:

a. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

b. Adjustable long-time delay.

c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

d. Adjustable short-time delay.

e. Short-time I square times t switch.

f. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

g. Adjustable ground-fault delay.

h. Ground-fault I square times t switch.

i. Ground-fault trip indicators shall be provided.

2.8 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. The Contractor shall provide a list of references complete with points of contact, addresses and

telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.8.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.8.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall utilize the fault current availability indicated as a basis for fault current studies.

2.8.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.8.4 Fault Current Analysis

2.8.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.8.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

2.8.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.8.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided describing: which devices may operate in the event of a fault at each bus; the logic used

to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.8.6 Study report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings.

d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 VERIFICATION OF DIMENSIONS

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Protective devices shall be installed in accordance with the manufacturer's published instructions and in accordance with the requirements of NFPA 70 and IEEE C2.

3.3 FIELD TESTING

3.3.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all

tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results.

3.3.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.3.3 Molded-Case Circuit Breakers

Circuit breakers shall be visually inspected, operated manually, and connections checked for tightness. Current ratings shall be verified and adjustable settings incorporated in accordance with the coordination study.

-- End of Section --

SECTION 26 32 15.00 10

DIESEL-GENERATOR SET STATIONARY 100-2500 KW, WITH AUXILIARIES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

ASME INTERNATIONAL (ASME)

ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24

ASTM INTERNATIONAL (ASTM)

ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 975	(2007) Standard Specification for Diesel Fuel Oils

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE C57.13	(1993; R 2003) Standard Requirements for Instrument Transformers
IEEE Std 1	(2000) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms

IEEE Std 115	(1995; R 2002) Test Procedures for Synchronous Machines: Part I: Acceptance and Performance Testing; Part II: Test Procedures and Parameter Determination for Dynamic Analysis
IEEE Std 120	(1989) Master Test Guide for Electrical Measurements in Power Circuits
IEEE Std 43	(2000) Testing Insulation Resistance of Rotating Machinery
IEEE Std 484	(2002) Recommended Practice for Installation Design and Implementation of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485	(1997) Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
IEEE Std 519	(1992) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) Normal Measurements

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2006) Standard for Motors and Generators
NEMA PB 1	(2006) Standard for Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 110	(2005) Standard for Emergency and Standby Power Systems
NFPA 30	(2003; Errata 2004; Errata 2006) Flammable and Combustible Liquids Code

NFPA 37	(2006) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2005; TIA 2005) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J537	(2000) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236	(2006) Standard for Safety Battery Chargers for Charging Engine-Starter Batteries

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

Detailed Drawings; G

SD-03 Product Data

Performance Criteria

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Cooling System

A letter which certifies that the engine-generator set and cooling system function properly in the ambient temperature specified, stating the following values:

a. The maximum allowable inlet temperature of the coolant fluid.

b. The minimum allowable inlet temperature of the coolant fluid.

c. The maximum allowable temperature rise in the coolant fluid through the engine.

Time-Delay on Alarms

The magnitude of monitored values which define alarm or action set points, and the tolerance (plus and/or minus) at which the devices

activate the alarm or action for items contained within the alarm panels.

Generator

Manufacturer's standard data for each generator (prototype data at the specified rating or above is acceptable), listing the following information:

a. Direct-Axis subtransient reactance (per unit).

b. The generator kW rating and short circuit current capacity (both symmetric and asymmetric).

Manufacturer's Catalog

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

Spare Parts

List of spare parts, as specified.

Onsite Training

A letter giving the date proposed for conducting the onsite training course, the agenda of instruction, a description of the video taping service to be provided, and the kind and quality of the tape to be left with the Contracting Officer at the end of the instructional period.

Battery Charger

Battery charger sizing calculations.

Instructions; G

Instructions including: the manufacturers pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall be weatherproof, laminated in plastic, and posted where directed.

Experience

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Field Engineer

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

General Installation

A copy of the manufacturer's installation procedures and a detailed description of the manufacturer's recommended break-in procedure.

SD-06 Test Reports

Factory Inspection and Tests

Six complete reproducible copies of the factory inspection result on the checklist format specified in paragraph FACTORY INSPECTION AND TESTS.

Factory Tests

a. A letter giving notice of the proposed dates of factory inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the manufacturer's procedures for factory tests at least 14 days prior to beginning tests.

c. Six copies of the Factory Test data described below in 215.9 x 279.4 mm binders having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs. Data plots shall be full size 215.9 x 279.4 mm, showing grid lines, with full resolution.

(1) A detailed description of the procedures for factory tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) A list of the parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of adjustments made.

Onsite Inspection and Tests; G

a. A letter giving notice of the proposed dates of onsite inspections and tests at least 14 days prior to beginning tests.

Prototype Test

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability

A reliability and durability certification letter from the manufacturer and assembler to prove that existing facilities are and have been successfully utilizing the same components proposed to meet this specification, in similar service. Certification may be based on components, i.e. engines used with different models of generators and generators used with different engines, and does not exclude annual technological improvements made by a manufacturer in the basic standard-model component on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets the performance requirements specified. Provide a list with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions

A certification from the engine manufacturer stating that the engine exhaust emissions meet the federal, state, and local regulations and restrictions specified. At a minimum this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HPAs).

Sound Limitations

A certification from the manufacturer stating that the sound emissions meet the specification.

Site Visit

A letter stating the date the site was visited and listing discrepancies found.

Current Balance

A certification stating that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment

A certification stating that where materials or equipment are specified to comply with requirements of UL, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Inspections

A letter certifying that all facilities are complete and functional; that each system is fully functional; and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Six copies of the operation manual (approved prior to commencing onsite tests) in 215.9 x 279.4 mm binders, having a minimum of 3 rings from which material may readily be removed and replaced, including a separate section for each system or subsystem. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 215.9 x 279.4 mm plastic pockets with reinforced holes. One full size reproducible mylar of each drawing shall accompany the booklets. Mylars shall be rolled and placed in a heavy cardboard tube with threaded caps on each end. The manual shall include: step-by-step procedures for system startup, operation, and shutdown; drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems together with their controls, alarms, and safety systems; the manufacturer's name, model number, and a description of equipment in the system. Each booklet shall include a CDROM containing an ASCII file of the procedures.

Maintenance Procedures

Six copies of the maintenance manual containing the information described below in 215.9 x 279.4 mm binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each item listed. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes.

a. Procedures for each routine maintenance item.

Procedures for troubleshooting.

Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. A copy of the posted instructions.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components specified for nameplates.

Six complete reproducible copies of the final relay and protective device settings. The settings shall be recorded with the name of the company and individual responsible for their accuracy.

Special Tools

Two complete sets of special tools required for maintenance (except for electronic governor handset). Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. The tools shall be supplied complete with a suitable tool box. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings.

Filters

Two complete sets of filters, required for maintenance, shall be supplied in a suitable storage box. These filters shall be in addition to filters replaced after testing.

Refer to Section 01 78 23, "OPERATION AND MAINTENANCE DATA".

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine-Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE-GENERATOR PARAMETER SCHEDULE

Power Rating	Prime
Overload Capacity (Prime applications only)	110% of Service Load for 1 hour in 12 consecutive hours
Service Load	kVA (maximum) as shown on plans kVA (continuous) as shown on plans
Power Factor	0.8 lagging
Engine-Generator Applications	stand-alone
Maximum Speed	1800 rpm
Heat Exchanger Type	fin-tube (radiator)
Frequency Bandwidth (steady state)	0.4%
Governor Type	Droop
Frequency Regulation (droop) (No Load to Full Load)	3% (maximum)
Frequency Bandwidth (steady state)	±0.4%
Voltage Regulation	± 2% (maximum)

(No Load to Full Load) (Stand alone applications)	
Voltage Bandwidth (steady state)	± 1%
Frequency	50 Hz
Voltage	380/220 volts
Phases	3 Phase, Wye
Max Time to Start and be Ready to Assume Load	10 seconds
Max Summer Outdoor Temp (Prior to Genset Operation)	± 50 degrees
Min Winter Outdoor Temp (Prior to Genset Operation)	- 40 degrees
Installation Elevation	Coordinate with Site Conditions

1.3.2 Rated Output Capacity

Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Ratings

Power ratings shall be in accordance with EGSA 101P.

1.3.4 Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine-generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

1.3.4 Reliability and Durability

Each prime engine-generator set shall have both an engine and a generator capable of delivering the specified power on a prime basis with an anticipated mean time between overhauls of not less than 10,000 hours operating with a 70% load factor. Two like engines and two like generators shall be cited that have performed satisfactorily in a stationary power plant, independent from the physical location of the manufacturer's and assembler's facilities. The engine and generators should have been in operation for a minimum of 8000 actual hours at a minimum load of 70% of the rated output capacity. During two consecutive years of service, the units should not have experienced any failure resulting in a downtime in excess of 72 hours. Like engines shall be of the same model, speed, bore, stroke,

number and configuration of cylinders and rated output capacity. Like generators shall be of the same model, speed, pitch, cooling, exciter, voltage regulator and rated output capacity.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified in paragraph SUBMITTALS.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number and rating on a plate secured to the equipment. As a minimum, nameplates shall be provided for:

Engines
Relays
Generators
Regulators
Governors
Pumps and pump motors
Generator Breaker

Where the following equipment is not provided as a standard component by the diesel engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger
Heaters
Exhaust mufflers
Battery

1.4.3 Personnel Safety Devices

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.4.4 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, NEMA, etc., the design, fabrication and installation shall also conform to the code.

1.4.5 Engine-Generator Set Enclosure

The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.6 Seismic Requirements

Generator sets to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04.

1.4.7 Detailed Drawings

The Contractor shall submit detailed drawings showing the following:

a. Base-mounted equipment, complete with base and attachments, including anchor bolt template and recommended clearances for maintenance and operation.

b. Complete starting system.

c. Complete fuel system.

d. Complete cooling system.

e. Complete exhaust system.

f. Layout of breakers and switches including applicable single line and wiring diagrams with written description of sequence of operation and the instrumentation provided.

1.4.8 Spare Parts

The Contractor shall submit a complete list of spare parts for each piece of equipment and a complete list of all material and supplies needed for continued operation. Lists shall include supply source and current prices. Each list shall be separated into two parts, those elements recommended by the manufacturer to be replaced after 3 years of service, and the remaining elements.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment, in accordance with the manufacturers recommended storage procedures,before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Filter Elements

Fuel-oil, lubricating-oil, and combustion-air filter elements shall be manufacturer's standard.

2.1.2 Instrument Transformers

NEMA C12.11.

2.1.3 Pipe (Sleeves, Fuel/Lube-Oil, and Exhaust)

ASTM A 53/A 53M, or ASTM A 106/A 106M steel pipe. Pipe smaller than 50 mm shall be Schedule 80. Pipe 50 mm and larger shall be Schedule 40.

a. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150 or ASME B16.11, 1360.7 kg.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturer's standard.

2.1.4 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.5 Electrical Enclosures

NEMA ICS 6.

2.1.5.1 Panelboards

NEMA PB 1.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel fuel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, supercharged, or turbocharged. The engine shall be 4-stroke-cycle and compression-ignition type. The engine shall be vertical in-line, V- or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have not less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The entire fuel system for each engine-generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.2 Fuel Filter

A minimum of one full-flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven pumps. System pressure shall be regulated as recommended by the engine manufacturer. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Lube-Oil Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.5 COOLING SYSTEM

Each engine shall have its own cooling system. Each system shall operate automatically while its engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across each engine shall not exceed that recommended and submitted in paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump.

2.5.2 in-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film, provided that correction measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via over sizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 48 kPa and shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes; one tapped hole shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Thermostatic Control Valve

A modulating type, thermostatic control valve shall be provided in the coolant system to maintain the coolant temperature range submitted in paragraph SUBMITTALS.

2.5.4 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 AIR INTAKE EQUIPMENT

Filters shall be provided in locations that are convenient for servicing. Provide enclosure with supply side 50 MM thick, high velosity, washable, zinc steel mech screen type air filter. Filter initial efficiency of 80 percent per UL Class I. Modify enclosure to accept air filters.

2.6.1 Sound Limitations

Sound Limitations shall be per the following table under the heading:

Frequency Band (Hz)	Maximum Acceptable Sound Level (Decibels)	
	Industrial	Residential
20-75	87	81
75-150	77	71
150-300	70	64
300-600	64	58
600-1,200	61	55
1,200-2,400	60	54
2,400-4,800	60	54
4,800-10 kHz	62	56

2.7 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported to minimize vibration. Where a V-type engine is provided, a V-type connector, with necessary flexible sections and hardware, shall connect the engine exhaust outlets.

2.7.1 Flexible Sections and Expansion Joints

A flexible section shall be provided at each engine and an expansion joint at each muffler. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.7.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 540 C degrees resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.7.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a drip leg for collection of condensate with drain valve and cap. Changes in direction shall be long radius. Exhaust piping, mufflers and silencers shall be insulated in accordance with specification Section 23 07 00, "THERMAL INSULATION FOR MECHANICAL SYSTEMS" and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing, rain cover.

2.8 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions, as listed.

2.9 STARTING SYSTEM

The starting system for engine generator sets used in non-emergency applications shall be as follows.

2.9.1 Controls

An engine control switch shall be provided with functions including: run/start(manual), off/reset, and, automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cooldown operation. The logic shall be arranged for manual starting. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.9.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15 second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.9.3 Electrical Starting

Manufacturers recommended dc system, utilizing a negative circuit ground.

2.9.3.1 Battery

A starting battery system shall be provided and shall include the battery, intercell connectors, spacers, automatic battery charger with overcurrent protection, metering and relaying. The battery shall be in accordance with SAE J537. Critical system components shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid, with sufficient capacity, at the minimum outdoor and maximum outdoor temperature specified, to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable. Furnish spare set of starting batteries for each generator.

2.9.3.2 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate which is manually adjustable in a continuous range and a floating charge rate for maintaining the batteries at fully charged condition. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage. A timer shall be provided for the equalize-charging-rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.9.4 Starting Aids

The manufacturer shall provide one or more of other following methods to assist engine starting.

2.9.4.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of -32 degrees C.

2.9.4.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 1.7 degrees C of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. Power for the heaters shall be 220 volts ac.

a. Prime Rated Sets

The control temperature shall be the higher of the manufacturer's recommended temperature or the minimum coolant inlet temperature of the engine recommended in paragraph SUBMITTALS.

2.10 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine-generator set, without special tools, from 90 to 110% of the rated speed/frequency, over a steady state load range of 0 to 100% or rated capacity. Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100% of rated output capacity.

2.11 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to the performance criteria in NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25% overspeeds, or voltages and temperatures at a rated output capacity of 110% for prime applications and 100% for standby applications. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.11.1 Current Balance

At 100% rated output capacity, and load impedance equal for each of the 3 phases, the permissible current difference between any 2 phases shall not exceed 2% of the largest current on either of the 2 phases.

2.11.2 Voltage Balance

At any balanced load between 75 and 100% of rated output capacity, the difference in line-to-neutral voltage among the 3 phases shall not exceed 1% of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25% load at unity power factor placed between any phase and neutral with no load on the other 2 phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3% of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25% load for single phase load conditions means 25% of rated current at rated phase voltage and unity power factor.

2.11.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced rated output capacity shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% of the fundamental at rated output capacity. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.12 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 4O degrees C ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.13 GENERATOR ISOLATION AND PROTECTION

Devices necessary for electrical protection and isolation of each engine-generator set and its ancillary equipment shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit withstand, and interrupting current ratings to match the generator capacity. The generator circuit breaker shall be manually operated. A set of surge capacitors, to be mounted at the generator terminals shall be provided.

2.14 SAFETY SYSTEM

2.14.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 3.1 m. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.14.2 Visual Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously lit upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to

normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.14.3 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm functions.

Device/Condition	What/Where/Size	NFPA 99	/Function
Shutdowns w/Alarms			
High engine temperature	Automatic/jacket/ water/cylinder	SD/CP VA	SD/CP VA
Low lube-oil pressure	Automatic/pressure/ level	SD/CP VA	SD/CP VA
Overspeed Shutdown& Alarm	(110 percent (± 2 % of rated speed)	SD/CP VA	
Overcrank, Failure to start	Automatic/Failure to start when used	SD/CP VA	SD/CP VA SD/CP VA
Red emergency stop switch	Manual Switch		SD/CP VA
Alarms			
Low fuel level	Main tank, 3 hrs remaining	VA/AA	CP VA
Low Coolant Temperature	jacket water	CP VA	CP VA
Pre-High Temperature	jacket water/ cylinder	CP VA	CP VA
Pre-Low Lube-oil Pressure		CP VA	
High battery Voltage			
Low battery Voltage			
Battery charger AC Failure	AC supply not available		

2.14.4 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.15 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc. shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.15.1 Controls

A local control panel shall be provided with controls mounted on or adjacent to the engine generator set.

Device/Condition/ Function	Corps Requirement
Controls	
Switch: run/start - off/reset - auto	CP
Emergency stop switch & alarm	CP
Lamp test/indicator test	CP
Common alarm contacts/ fault relay	
Panel lighting	CP
Audible alarm & silencing/reset switch	CP
Voltage adjust for voltage regulator	CP
Remote emergency stop switch	

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturers standard connection is threaded. Except where otherwise specified, welded flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other

system's equipment or piping. Connections to equipment shall be made with vibration-isolation-type flexible connectors. Piping and tubing shall be supported and aligned to prevent stressing of flexible hoses and connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors and openings, to permit thermal expansion and contraction without damage to joints or hangers, and shall be installed with a 13 mm drain valve with cap at each low point.

3.2.1 Support

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 2.1 m on center for pipes 50 mm in diameter or less, not more than 3.6 m on center for pipes larger than 50 mm but smaller than 100 mm in diameter, and not more than 5.2 m on center for pipes larger than 100 mm in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.1.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized Type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized Type 1 clevis and threaded rods.

3.2.1.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized Type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.2 Flanged Joints

Flanges shall be Class 125 type, drilled, and of the proper size and configuration to match the equipment and diesel engine connections. Flanged joints shall be gasketed and made up square and tight.

3.2.3 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of debris.

3.2.4 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be minimum 13 mm, and where pipes pass through combustible materials 25 mm larger than the outside diameter of the passing pipe or pipe insulation/covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. For vibration isolation, flexible fittings shall be provided for conduit, and raceways attached to engine-generator sets; metallic conductor cables installed on the engine generator set and

from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor; and terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of all parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments, replacements, or repairs shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be recorded in 15 minute intervals during engine-generator set operation and shall include: readings of all engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set.Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions of terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulations shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

For all engine-generator set operating tests the load power factor shall be the power factor specified in the engine-generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments provided as permanent equipment shall be verified during test runs, using test instruments of greater precision and accuracy. Test instrument accuracy shall be within the following: current plus or minus 1.5%, voltage plus or minus 1.5%, real power plus or minus 1.5%, reactive power plus or minus 1.5%, power factor plus or minus 3%, frequency plus or minus 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however, the following general order of testing shall be followed: Construction Tests;

Inspections; Pre-operational Tests; Safety Run Tests; Performance Tests; and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine-generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but not less than 1.03 MPa, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repair cable shall be retested until failures have been eliminated.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall

verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil sump drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil level indicator. (I)
18. Lube-oil fill level. (I)
19. Lube-oil line connections. (I)
20. Lube-oil lines. (I)
21. Fuel type. (D)
22. Fuel-level. (I)
23. Fuel-line connections. (I)
24. Fuel lines. (I)
25. Fuel filter. (I)
26. Access for maintenance. (I)
27. Voltage regulator. (I)
28. Battery-charger connections. (I)
29. Wiring & terminations. (I)
30. Instrumentation. (I)
31. Hazards to personnel. (I)
32. Base. (I)
33. Nameplates. (I)
34. Paint. (I)
35. Exhaust-heat system. (I)
36. Exhaust muffler. (I)
37. Switchboard. (I)
38. Switchgear. (I)
39. Access provided to controls. (I)
40. Enclosure is weather resistant. (I)
41. Engine & generator mounting bolts (application). (I)

3.5.4 Pre-operational Tests

3.5.4.1 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the installation coordination study. Relay contacts shall be manually or

electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.1.

3.5.4.2 Insulation Test

Generator and exciter circuits insulation resistance shall be tested in accordance with IEEE Std 43. Results of insulation resistance tests shall be recorded. Readings shall be within limits specified by the manufacturer. Mechanical operation, insulation resistance, protective relay calibration and operation, and wiring continuity of assembly shall be verified. Precautions shall be taken to preclude damaging generator components during test.

3.5.4.3 Engine-Generator Connection Coupling Test

When the generator provided is a two-bearing machine, the engine-generator connection coupling shall be inspected and checked by dial indicator to prove that no misalignment has occurred. The dial indicator shall measure variation in radial positioning and axial clearance between the coupling halves. Readings shall be taken at four points, spaced 90 degrees apart. Solid couplings and pin-type flexible couplings shall be aligned within a total indicator reading of 0.012 to 0.025 mm for both parallel and angular misalignment. For gear-type or grid-type couplings, 0.05 mm will be acceptable.

3.5.5 Safety Run Test

For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated safety tests shall be repeated.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine-generator set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If either temperature reading exceeds the value required for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm

activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily install a temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period. Operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 2 hours at 75% of Service Load.

l. Verify proper operation and setpoints of gauges and instruments.

m. Verify proper operation of ancillary equipment.

n. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

o. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75% of Service Load.

p. Manually adjust the governor to increase engine speed to within 2% of the overspeed trip speed previously determined and operate at that point for 5 minutes. Manually adjust the governor to the rated frequency.

q. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine.

r. Attach a manifold to the engine oil system (at the oil pressure sensor port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold. The manifold shutoff valve shall be open and bleed valve closed.

s. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75% of Service Load.

t. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

u. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of Service Load. Record the maximum sound level in each frequency band at a distance of 22.9 m from the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 22.9 m from the engine at 45 degrees apart in all directions for vertical piping. If a sound limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intake silencer, the Contractor shall notify the Contracting Officers Representative and provide a recommendation for meeting the sound limitations.

3.5.6 Performance Tests

In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated tests shall be repeated.

3.5.6.1 Continuous Engine Load Run Test

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature of 22 degrees C, during the month of June. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Data taken at 15 minute intervals shall include the following:

Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

Pressure: Lube-oil.

Temperature: Coolant.
Lube-oil.
Exhaust.
Ambient.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.

c. Operate the engine generator-set for 2 hours at 75% of Service Load.

d. Increase load to 100% of Service Load and operate the engine generator-set for 4 hours.

e. For prime rated units, increase load to 110% of Service Load and operate the engine generator-set for 2 hours.

f. Decrease load to 100% of Service Load and operate the engine generator-set for 2 hours or until all temperatures have stabilized.

g. Remove load from the engine-generator set.

3.5.6.2 Voltage and Frequency Droop Test

For the following steps, verify that the output voltage and frequency return to and stabilize within the specified bandwidth values following each load change. Record the generator output frequency and line-line and line-neutral voltages following each load change.

a. With the generator operating at no load, adjust voltage and frequency to rated voltage and frequency.

b. Increase load to 100% of Rated Output Capacity. Record the generator output frequency and line-line and line-neutral voltages.

c. Calculate the percent droop for voltage and frequency with the following equations.

$$\text{Voltage droop \%} = \frac{\text{No-load volts - rated output capacity volts}}{\text{Rated output capacity volts}} \times 100$$

$$\text{Frequency droop \%} = \frac{\text{No load hertz - rated output capacity hertz}}{\text{Rated output capacity volts}} \times 100$$

d. Repeat steps a. through c. two additional times without making any adjustments.

3.5.6.3 Voltage Regulator Range Test

a. While operating at no load, verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

b. Increase load to 100% of Rated Output Capacity. Verify that the voltage regulator adjusts from 90% to 110% of rated voltage.

3.5.6.4 Governor Adjustment Range Test

a. While operating at no load, verify that the governor adjusts from 90% to 110% of rated frequency.

b. Increase load to 100% of Rated Output Capacity. Verify that the governor adjusts from 90% to 110% of rated frequency.

3.5.6.5 Frequency and Voltage Stability and Transient Response

Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer. Tabular data shall include the following:

(1.) Ambient temperature (at 15 minute intervals).

(2.) Generator output current (before and after load changes).

(3.) Generator output voltage (before and after load changes).

(4.) Frequency (before and after load changes).

(5.) Generator output power (before and after load changes.

(6.) Graphic representations shall include the actual instrument trace of voltage and frequency showing:

Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.

c. With the unit at no load, apply the Maximum Step Load Increase.

d. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.

e. Repeat steps c. and d.

3.5.7 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate loading and unloading of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

(1.) Ambient temperature (at 15 minute intervals).

(2.) Generator output current (before and after load changes).

(3.) Generator output voltage (before and after load changes).

(4.) Generator output frequency (before and after load changes).

a. Initiate loss of the primary power source and verify automatic sequence of operation.

b. Restore the primary power source and verify sequence of operation.

c. Verify resetting of controls to normal.

3.5.8 Fuel Consumption Tests

Fuel consumption tests to confirm the manufacturer's certified rates shall be performed on engine generator set and the results tabulated and averaged. Fuel consumption tests shall be conducted under the direct supervision of the engine manufacturer's representative. Fuel consumption readings shall be taken at 15 minute intervals, over a minimum period of 1 hour at 50% Service Load, 1 hour at 75% Service Load, and 4 hours at 100% Service Load. Fuel consumption data may be taken during the 75% load test and 100% load tests. Fuel consumption readings at site conditions shall be correlated to the guarantee-baseline conditions. Test report shall contain: readings of the output frequency, voltage, current, power factor, and power; barometric pressure; ambient temperature; intake-air temperature; fuel temperature; the site fuel consumption readings, adjustment calculations, factors, and source references for correlation of actual consumption rate of the guaranteed rate.

a. Start and operate the generator set and allow it to stabilize at rated load, rated voltage and rated frequency. During this period, readings of all instruments including thermal instrumentation shall be recorded at minimum intervals of 10 minutes. If necessary, adjustments to the load, voltage and frequency may be made to maintain rated load at rated voltage and rated frequency. However, adjustments to the voltage and frequency shall be limited to those adjustments available to the operator, specifically adjustments to the voltage or frequency adjust devices. On generator sets utilizing a droop-type speed control system as the prime speed control, the speed and droop portions of the control may be adjusted. No other adjustments to the voltage and frequency control systems shall be made unless permitted by the procurement document. Adjustments to the load, voltage or frequency controls shall be recorded on the data sheet. Unless otherwise specified in the procurement document, stabilization will be consideration to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor

variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage or frequency has been made.

b. Perform one of the following procedures:

BALANCE SCALE PROCEDURE.

(1.) Supply fuel from auxiliary container mounted on a balance scale.

(2.) After stabilization has occurred, set the balance weights at any convenient value slightly less than the total weight of the fuel and container.

(3.) Start the stopwatch when the balance weights fall and record the total weight.

(4.) Reduce the balance weight a convenient amount and record the amount of the weights removed.

(5.) Stop the stopwatch when the balance weights fall and record the total weight and the elapsed time.

(6.) Repeat steps (1) thru (2) above until the timed portion of the test exceeds the 2 hours.

(7.) From the total elapsed time and total of the weights removed calculate the fuel consumption in terms of pounds per hour.

(8.) Using the value obtained in step (7) above, compute the rate of fuel consumption per kilowatt hour, as follows:

$$\text{Pounds per kWH} = \frac{\text{Fuel Consumption in Pounds per Hour}}{\text{kW Load}}$$

(9.) Repeat the test for each load condition specified.

(10.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(11.) For each specified load, compute the number of continuous hours the generator set will operate on a full tank of fuel. The following formula shall be used.

$$\text{Operating hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per hour)}}$$

ALTERNATE PROCEDURE FOR WEIGHING FUEL

(1.) Supply fuel from the auxiliary fuel container, mounted on a platform balance, or other weighing device.

(2.) After stabilization has occurred, record weight readings every one-half hour for a period of 2 hours.

(3.) Calculate the average hourly fuel consumption rate in pounds per hour.

(4.) Using the average hourly fuel consumption rate obtained above, compute the rate of fuel consumption per kilowatt hour, as follows:

$$\text{Pounds per kWH} = \frac{\text{Fuel Consumption}}{\text{kW Load}}$$

(5.) Repeat test for each load condition specified.

(6.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(7.) for each specified load test, compute the number of continuous ours the generator set will operate on a full tank of fuel. The following formula shall be used:

$$\text{Operating Hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per Hour)}}$$

ALTERNATE PROCEDURE USING FLOWMETER.

Flowmeters may be used to determine the fuel rate. They usually are calibrated in either gallons per hour, or pounds per hour, for a fuel of a definite specific gravity and temperature.

(1.) After stabilization has occurred record the fuel consumption rate, and continue to record the fuel consumption rate at one-half hour intervals for 2 hours.

(2.) Determine the average of the readings (correct for fuel specific gravity and temperature). This is the fuel consumption rate and should be converted, if necessary, to pounds per hour.

(3.) Using the average value obtained above, calculate the rate of fuel consumption per kilowatt hour.

(4.) Repeat the test for each load condition specified.

(5.) Determine the capacity of the generator set fuel tank in pounds of fuel.

(6.) For each specified load test, compute the number of continuous hours the generator set will operate on a full tank of fuel. The following formula shall be used:

$$\text{Operating Hours} = \frac{\text{Fuel Tank Capacity (Pounds)}}{\text{Fuel Consumption (Pounds per Hour)}}$$

c. Results. Compare the operating hours or the fuel consumption rate per kWH.

3.5.9 Final Testing and Inspection

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the Maximum Step Load Increase to 100% of Service Load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 8 hours at Service Load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.6 POSTED DATA AND INSTRUCTIONS

Posted Data and Instructions shall be posted prior to field acceptance testing of the engine generator set. Two sets of instructions/data shall be typed and framed under weatherproof laminated plastic, and posted side-by-side where directed. First set shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions.

3.7 ONSITE TRAINING

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. All operation and maintenance manuals shall bee approved and made available for the training course. All posted instructions shall be approved and posted prior to the beginning date of the training course. The training course schedule shall be coordinated with the Using Service's work schedule, and submitted for approval 14 days prior to beginning date of proposed beginning date of training. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as major

elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate routine maintenance procedures as described in the operation and maintenance manuals.

3.8 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 26 41 00.00 20

LIGHTNING PROTECTION SYSTEM
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition
NFPA 780	(2007) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 96	(2005) Standard for Lightning Protection Components
UL 96A	(2007) Standard for Installation Requirements for Lightning Protection Systems
UL Electrical Constructn	(2008) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.2.1 Verification of Dimensions

Contractor shall become familiar with all details of work, verify all dimensions in field, and shall advise Contracting Officer of any discrepancy

before performing work. No departures shall be made without prior approval of Contracting Officer.

1.2.2 System Requirements

Materials shall consist of standard products of a manufacturer regularly engaged in production of lightning protection systems and shall be manufacturer's latest UL approved design. Lightning protection system shall conform to NFPA 70, NFPA 780, UL 96 and UL 96A.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][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

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Grounding system test; G

Lightning protection system inspection; G

SD-07 Certificates

UL listing or label; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

a. Submit installation shop drawing for the overall lightning protection system. Drawings shall include physical layout of the equipment, mounting details, relationship to other parts of the work, and wiring diagram.

b. Submit detail drawings for each major component to include manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 UL Listing or Label

Submit proof of compliance. Label of or listing in UL Electrical Constructn is acceptable evidence. In lieu of label or listing, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.5 SITE CONDITIONS

Contractor will become familiar with details of the work, verify dimensions in the field, and advise Contracting Officer of discrepancies before performing work. Deviations from contract drawings will not be made without prior approval of Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, increase conductor size to compensate for hazard or protect conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic).

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper

Provide copper conductors on nonmetallic stacks that do not weigh less than 144.83 kg per 305 meters, and provide cable such that the size of any strand in the cable is not less than No. 15 AWG. Provide thickness of web or ribbon on stacks that is not less than No. 12 AWG. Provide loop conductors that are comprised of copper conductors not smaller than No. 1/0 AWG.

2.1.3 Aluminum

Do not allow aluminum to contact the earth and do not use in any other manner that will contribute to rapid deterioration of the metal. Observe appropriate precautions at connections with dissimilar metals in accordance with NFPA 70 Article 110-14. Provide aluminum cable conductors for bonding and interconnecting metallic bodies to main cable that are at least equivalent to strength cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, use strips that are much wider than solid strips. Use a strip width that is at least twice that of the diameter of the perforations. Use an aluminum strip which has a thickness of not less than the diameter of No. 12 AWG and at least 40 mm wide for connecting exposed water pipes.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide terminals in accordance with UL 96, except provide Class II for Class I and Class II applications. Support air terminals more than 610 mm in length by suitable brace, with guides, not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide [ground rods made of [copper-clad steel] [stainless steel] [solid copper] conforming to conform to UL 467.] [galvanized ferrous rods conforming to ANSI C135.30.] Provide ground rods that are not less than 20 mm in diameter and 3050 mm in length. Do not mix ground rods of copper-clad steel, stainless steel, galvanized ferrous, or solid copper on the job.

2.2.3 Grounding Plates

Provide grounding plates made of [copper-clad steel][iron][stainless steel] [solid copper] conforming to UL 96.

2.2.4 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.5 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

2.2.6 Lightning Protection Components

Provide bonding plates, air terminal supports, chimney bands, clips, and fasteners that conform to UL 96 classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use nonconducting parts of the structure as part of the building's lightning protection system. Expose conductors on the structures except where conductors are required to be in protective sleeves. Interconnect secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or above the level of the grounded metallic parts.

3.1.1 Air Terminals

Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, roof conductors by

means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 610 mmfrom ends of ridges and corners of roofs. Do not exceed 7620 mm in spacing of 610 mm high air terminals on ridges, parapets, and around perimeter of building with flat roofs. When necessary to exceed this spacing, increase specified height of air terminals not less than 50 mm for each 305 mm of increase over 7620 mm. On large flat, or gently sloping roofs, as defined in NFPA 780, place air terminals at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 15 m in length. Secure air terminals against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces which are permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings such as smokestacks and other metal objects that are at least 4.763 mm thick and that do not contain hazardous materials, need not be provided with air terminals. However, bond these metal objects to a lightning conductor through a metal conductor of the same unit weight per length as the main conductor. [Where metal ventilators are installed, mount air terminals thereon, where practical. Bond air terminals, erected by necessity adjacent to a metal ventilator, to the ventilator near the top and bottom.] Where nonmetallic spires, steeples, or ventilators are present, mount air terminals to the side. In addition, where spires or steeples project more than 3050 mm above the building, continue conductor from air terminal to nearest down conductor securely connect thereto.

3.1.2 Roof Conductors

Connect roof conductors directly to the roof or ridge roll. Avoid sharp bends or turns in conductors. Do not make turns of less than 205 mm. Preserve horizontal or downward course on conductors. Rigidly fasten conductors every 915 mm along the roof and down the building to the ground. Rigidly connect metal ventilators to the roof conductor at three places. Make connections electrically continuous. Course roof conductors along contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Connect roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs to form a closed loop.

3.1.3 Down Conductors

Make down conductors electrically continuous from air terminals and roof conductors to grounding electrodes. Course down conductors over outer extreme portions of the building, such as corners, with consideration given to location of ground connections and air terminals. Provide each building or structure not less than two down conductors located as widely separated as practicable, such as at diagonally opposite corners. [Rectangular structures having gable, hip, or gambrel roofs more than 33 m long, provide at least one additional down conductor for each additional 15 m of length or fraction thereof.] [Rectangular structures having French, flat, or sawtooth roofs exceeding 76 m in perimeter, provide at least one additional down conductor for each 30 m of perimeter or fraction thereof.] [L- or T-shaped structure, provide at least one additional down conductor.] [H-shaped structure, at least two additional down conductors.] [Wing built structure, at least one additional down conductor for each wing.] [Irregularly shaped structures, provide enough conductors so that the average distance between them along the perimeter is not greater than 30 m.] [Structures exceeding 15 m in height,

provide at least one additional down conductor for each additional 18 m of height or fraction thereof, except that this application will not cause down conductors to be placed about the perimeter of the structure at intervals of less than 15 m.] Install additional down conductors when necessary to avoid "dead ends" or branch conductors exceeding 5 m in length, ending at air terminals. Equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent physical damage or displacement to the conductor.

3.1.4 Interconnection of Metallic Parts

Connect metal doors, windows, and gutters directly to ground or down conductors using not smaller than No. 6 copper conductor, or equivalent. Where there is probability of unusual wear, mechanical injury, or corrosion, provide conductors with greater electrical capacity than normal or protect the conductor. Provide mechanical ties or pressure connectors between grounds and metal doors and windows.

3.1.5 Ground Connections

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Provide a ground connection for each down conductor. Attach down conductors to ground [rods] [plates] by welding (including exothermic), brazing, or clamping. Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. Bond metal water pipes and other large underground metallic objects together with all grounding mediums. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.6 Grounding Electrodes

Provide grounding electrode for each down conductor. Extend driven ground rods into the existing undisturbed earth for a distance of not less 3050 mm. Set ground rods not less than 610 mm nor more than 3050 mm, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE Std 81. Maximum resistance of a driven ground rod shall be [10] [_____] ohms, under normally dry conditions [when a ground loop is not used]. Use a ground loop when two of any three ground rods, driven not less than 3050 mm into the ground, a minimum of 3050 mm apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground loop, provide continuous No. 1/0 bare stranded copper cable or equivalent material having suitable resistance to corrosion. Lay ground loop around the perimeter of the structure in a trench not less than 765 mm below grade, at a distance not less than 610 mm nor more than 3050 mm from the nearest point of the structure. Install a ground loop in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable. Make connections between ground conductors and grounds or ground loop, and between ground loop and grounds electrically continuous. [Where so indicated, provide an alternate method for grounding electrodes in shallow soil by digging trenches radially from the building. Provide 1/0 bare copper cable arranged in a star pattern with the structure

at the center for radial systems. Bury the radials at least 765 mm inches below grade external to the structure. Lower ends of down conductors [or their equivalent in the form of metal strips or wires] are buried in trenches].

3.1.7 Grounding Plates

Provide a grounding plate for down conductor. Set grounding plates not less than 610 mm nor more than 3050 mm, from the structure. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding 3050 mmin depth.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous. Connect air terminals so that they are electrically continuous with the metal roof as well as the roof conductors and down conductors. Bond ridge cables and roof conductors to the roof at upper and lower edges of roof and at intervals not to exceed 30 m. Bond down conductors to roof conductors and to lower edge of metal roof. Where metal of roof is in small sections, make connections between air terminals and down conductors to at least four sections of the metal roof. Make connections electrically continuous and have a surface contact of at least 1935 square mm.

3.2.2 Metal Roofs with Metal Walls

Bond metal roof and metal walls so that they are electrically continuous and considered as one unit. Connect air terminals to and make them electrically continuous with the metal roof as well as the roof down conductors. Bond all roof conductors and down conductors to metal roof or metal walls at upper and lower edges at intervals not to exceed 30 m. Make all connections electrically continuous and have surface contact of at least 1935 square mm.

3.2.3 Steel Frame Building

Make the steel framework of the building electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding unless another specific method is indicated. Connect air terminals to the structural steel framework at the ridge. Provide short runs of conductors to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where water system enters the building, securely connect structural steel framework and water system at point of entrance by a ground connector. Make connections to pipes by means of ground clamps with lugs. Make connections to structural framework by means of nut and bolt or welding. Make connections between columns and ground connections at bottom of steel columns. Make ground connections to grounds or ground loop runs from not less than one-half of the columns distributed equally around perimeter of structure. When no water system enter the structure, run ground connections from steel columns distributed equally around the perimeter of the structure. Bond metal doors, windows, gutters, and similar metal installation to steel work of the building. Provide a grounding electrode for each ground connection.

3.2.4 Ramps and Covered Passageways

Ramps and covered passageways which are in the zone of protection of a lightning protection system, as defined by NFPA 780, need no additional lightning protection. However, ramps and covered passageways which are outside the zone of protection of a lightning protection system shall be provided with a lightning protection conforming to the requirements for lightning protection systems for buildings of similar construction. Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground loop or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, connect metal of the buildings or structures and metal of the ramp in a manner to ensure electrical continuity, in order to avoid the possibility of a flash-over or spark due to a difference in potential. Make connections electrically continuous and have a surface contact area of at least 1935 square mm.

3.2.5 Tanks and Towers

3.2.5.1 Wooden Tanks and Towers

Electrically interconnect lightning protection system components (such as: air terminals, ridge cables, down conductors, ground connections, and grounds) to form the shortest distance to ground without passing through any nonconducting parts of the structure. Where the roof of the structure ends in a peak, a single air terminal not less than 610 mmhigh will be regarded as sufficient. When structure does not end in a peak, provide air terminals not less than 610 mm high at intervals not exceeding 7620 m along the perimeter of the structure. When the tank or tower is an adjunct of a building, near or touching the perimeter, extend one of the down conductors directly to a ground connection and connect the other to lightning protection of the building. When tank or tower is set well within the perimeter of the building, connect both down conductors to lightning protection system of the building. When height of the structure exceeds 30 m, cross-connect down conductors midway between the top and bottom. Where buried metal pipes enter tank or tower, connect one down conductor to pipes, approximately 305 mm below grade. Ground metal guy wires or cables set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.5.2 Metal or Reinforced-Concrete Tanks and Towers

Make metal or reinforcing steel electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding metal and tying or clipping reinforcing bars, unless a specific method is noted on the drawings. Air terminals and down conductors are required except on bolted, riveted, or welded 4.75 mm minimum steel plate tanks. Ground connections and grounding electrodes are not required on metal tanks that are electrically continuous with a metallic underground pipe system. On other structures, provide two ground connections approximately 3.14 rad apart at the base of the structure. Connect each buried metal pipe entering the tank or tower to one ground connection approximately 305 mm below finished grade. Ground metal guy wires on tanks and towers. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as grounded. Ground metal guy wires or cables set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.6 Stacks

Ground metal guy wires for stacks. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as sufficiently well grounded. However, ground metal guy wires or cables attached to anchor rods set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.6.1 Metal Stacks

Make metal smokestacks electrically continuous and to ground. Heavy-duty metal stacks having a metal thickness of 4.75 mm or greater do not require air terminals or down conductors. Otherwise, provide two [ground rods][grounding plates] driven full length into the earth. Locate [ground rods][grounds plates] approximately 3.14 rad apart and set [ground rods] [grounding plates] not less than 915 mm nor more than 2440 mm from the nearest point of the stack foundation.

3.2.6.2 Nonmetallic Stacks

On nonmetallic smokestacks constructed of brick, hollow tile, or concrete, make the air terminals solid copper, copper alloy, stainless steel or Monel metal. Distribute uniformly about the rim of the stack at intervals not exceeding 2440 mm and extending at least 765 mm above the rim of stack. Electrically connect air terminal together by means of a metal band or ring to form a closed loop about 610 mm below the top of the stack. Where the stack has a metal crown, connect air terminals to the metal crown. Where stacks have metal lining extending part way up, connect lining to air terminal at its upper end and ground at the bottom. Provide at least two down conductors on opposite sides of the stack leading from the ring or crown at the top to the ground. When the stack is an adjunct of building near or touching the building perimeter, extend one of the conductors directly to a ground connection while the other may be connected to lightning protection system on the building. On stacks exceeding 48 m in height, cross-connect down conductors approximately midway between the top and bottom. Reduce joints in conductors to a minimum and make joints to have the same tension strength as the conductors that are joining. Space fasteners of copper or copper-bronze alloy not over 915 mmapart for vertical conductors and not over 610 mm apart for horizontal conductors. To prevent gases from corroding copper air terminals, provide conductors and fasteners within 7620 mmof the top of stack with continuous coating of hot dipped lead or an equivalent coating. Provide conductors conforming to the requirements for nonmetallic stacks for stacks partly or wholly of reinforced concrete. For nonmetallic stacks, electrically connect reinforcing steel to down conductors at top and bottom of concrete.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Interconnection of Metal Bodies

Protect metal bodies when not within the zone of protection of air terminal. Bond metal bodies having an area of 0.258 square m or greater or a volume of 0.016387 cubic m or greater to lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 1935 square mm. Make provisions to guard against the corrosive effect of bonding dissimilar metals. Bond metal bodies at their closest point to the

lightning protection system using bonding conductors and fittings. Independently ground any metal body that exceeds 1525 mm in any dimension, that is situated wholly within a building, and that does not at any point come within 1830 mm of a lightning conductor or metal connected to a lightning protection system.

3.3.2 Fences

Except as specified below, metal fences that are electrically continuous with metal posts extending at least 610 mm into the ground require no additional grounding. Ground other fences on each side of every gate at gate posts, at corner posts, and at end posts. Bond gate to adjacent fence post utilizing flexible copper grounding braid with sufficient slack to permit 3.14 rad opening of the gate. Provide flexible copper ground braid which has an ampacity equivalent to that of the fence ground wire specified herein. Provide [ground rods][grounding plates] every 305 to 457 m for grounding fences when fences are located in isolated places, and every 152 to 228 m when in proximity (30 m or less) to public roads, highways, and buildings. Provide connection to ground from the post where it is metal and is electrically continuous with the fencing using removable ground clamps on the fence posts and split-bolt connectors suitable for dissimilar metals on the fence fabric and barbed wire. [Where the fence consists of wooden posts and horizontal metal strands only, run down conductors consisting of No. 8 copper wire or equivalent from the ground rod the full height of the fences and fastened to each wire, so as to be electrically continuous.] Make connections to ground from the horizontal metal strand using split-bolt connectors suitable for dissimilar metals on the fence fabric and barbed wire. Ground metal fences at or near points 45 m on each side of medium and high voltage, (meaning in excess of 600 volts,) overhead line crossings. Ground metal fences at 45 m intervals where high and medium voltage lines are directly overhead and run parallel to the fence.

3.3.3 Exterior Overhead Pipe Lines

Properly ground overhead pipes, conduits, and cable trays on the exterior of the building that enter a building, preferably to building grounds at points where pipes enter the building. Where a separate ground is provided, bond the pipes to the building ground at points where the pipes are closest to the ground connections. In addition, bond pipes to any metallic masses that are within 1830 mm of the pipe.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore to original condition the areas disturbed by trenching, storing of dirt, cable laying, and other work. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Grounding System Test

Test the grounding system to ensure continuity and that resistance to ground is not in excess of 10ohms. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and

test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of ground rods, resistance, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

3.5.2 Lightning Protection System Inspection

Make visual inspections to verify that there are no loose connections which may result in high resistance joints, and that conductors and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING
07/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 1008/A 1008M	(2006a) 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

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	(2000; Errata 2004; Errata 2005) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C78.1381	(1998) Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
NEMA C78.81	(2005) Electric Lamps - Double-capped Fluorescent Lamps Dimensional and Electrical Characteristics
NEMA C82.1	(2004) Electric Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts
NEMA C82.11	(2002) High-Frequency Fluorescent Lamp Ballasts
NEMA C82.2	(2002) Methods of Measurement of Fluorescent Lamp Ballasts

NEMA ICS 6	(2006) Standard for Industrial Controls and Systems Enclosures
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP Extraction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2006) Life Safety Code, 2006 Edition
NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 90A	(2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1598	(2004; Rev thru May 2006) Luminaires
UL 20	(2004) Standard for General-Use Snap Switches
UL 924	(2001; R 2005e8) Standard for Emergency Lighting and Power Equipment
UL 935	(2001; Rev thru Feb 2006) Standard for Fluorescent-Lamp Ballasts

1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

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

otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IESNA HB-9, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures; G,

Fluorescent electronic ballasts; G,

Fluorescent electromagnetic ballasts; G,

Fluorescent lamps; G,

Incandescent lighting fixtures; G,

Incandescent lamps; G,

Exit signs; G,

Emergency lighting equipment; G,

Environmental Data

Energy Efficiency

SD-04 Samples

Lighting fixtures, complete with lamps and ballasts; G,

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5; G,

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type for inspection, review, and approval. The sample shall be retained for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5.4.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

1.7 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1598. Fluorescent fixtures shall have electronic ballasts.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, NEMA C82.11, NFPA 70, and CEC Title 24 unless specified otherwise. Ballast shall be 100% electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of

occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

f. Ballast shall be UL listed Class P with a sound rating of "A."

g. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

h. Ballasts shall be instant start unless otherwise indicated. Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

i. Ballasts for compact fluorescent fixtures shall be programmed start.

j. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

k. Ballast shall be capable of starting and maintaining operation at a minimum of -17 degrees C unless otherwise indicated.

l. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 20 percent (maximum).

b. Input wattage.

1. 32 watts (maximum) when operating one F32T8 lamp

2. 62 watts (maximum) when operating two F32T8 lamps

c. Ballast efficacy factor.

1. 2.54 (minimum) when operating one F32T8 lamp

2. 1.44 (minimum) when operating two F32T8 lamps

d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.1.2 Fluorescent Lamp Electronic Dimming Ballast

2.1.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

a. 35 watts (maximum) when operating one F32T8 lamp.

b. 70 watts (maximum) when operating two F32T8 lamps.

c. 104 watts (maximum) when operating three F32T8 lamps.

2.1.3 Fluorescent Electromagnetic Ballasts

2.1.3.1 Electromagnetic Energy-Saving Ballasts

NEMA C82.1. Provide energy-saving fluorescent ballasts of the CBM certified full light output type except where fixtures are provided with low temperature ballasts. Ballasts shall have an average input wattage of 40 or less when operating one 32-watt F32T8 lamp or 72 or less when operating two 32 watt F32T8 lamps tested in accordance with NEMA C82.2 methods.

2.1.3.2 Electromagnetic Low Temperature Ballasts

Provide fluorescent ballasts having a minimum starting temperature of minus 28 degrees C in rooms, outdoors, in unheated buildings, and as indicated.

2.1.4 Fluorescent Lamps

a. T-8 rapid start low mercury lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

Average rated life is based on 3 hours operating per start.

2.2 INCANDESCENT LIGHTING FIXTURES

Use of incandescent lamps and fixtures is prohibited, unless specifically indicated otherwise. UL 1598.

2.2.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.3 SWITCHES

2.3.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.4 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type. Exit signs shall use no more than 5 watts.

2.4.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack.

Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

2.5 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated. Provide accessories required for remote-mounted lamps where indicated. Remote-mounted lamps shall be as indicated.

2.5.1 Fluorescent Emergency System

Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Provide self-testing module integral to the fixture. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to the number of lamps shown for each system for 90 minutes at a minimum of 1100 lumens per lamp output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts provided with fixtures containing solid-state ballasts shall be fully compatible with the solid-state ballasts. Furnish spare emergency ballast based on 10 percent of the number of emergency ballast provided for the project.

2.6 SELF-TESTING MODULE

Self-testing module for exit signs and emergency lighting equipment shall perform the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

2.7 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.7.1 Wires

ASTM A 641/A 641M, galvanized regular coating, soft temper, 2.68 mm in diameter.

2.7.2 Wires, for Humid Spaces

ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel 2.68 mm in diameter.

ASTM B 164, UNS NO4400, annealed nickel-copper alloy 2.68 mm in diameter.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-8), tube configuration, base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (rapid start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper

operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures shall be independently supported from the building structure by a minimum of four wires per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 19 mm metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires for lighting fixture support in this section.

3.1.3 Suspended Fixtures

Suspended fixtures shall be provided with 0.79 rad swivel hangers so that they hang plumb and shall be located with no obstructions within the 0.79 rad range in all directions. The stem, canopy and fixture shall be capable of 0.79 rad swing. Pendants, rods, or chains 1.2 meters or longer excluding fixture shall be braced to prevent swaying using three cables at 2.09 rad separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 3.1 meters or as recommended by the manufacturer, whichever is less.

3.1.4 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

-- End of Section --

SECTION 26 56 00

EXTERIOR LIGHTING
07/06

PART 1 GENERAL

1.1 REFERENCES

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

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002; 2004s; Supple A 2003; Supple B 2003; Supple C 2004) Specifications and Dimensions (for Wood Poles)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-4	(2006) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 108	(2006) Standard Specification for Aluminum-Alloy Permanent Mold Castings

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	(2000; Errata 2004; Errata 2005) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C136.10	(1996) American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
IEEE C2	(2005) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C136.3	(2005) Roadway and Area Lighting Equipment Luminaire Attachments
NEMA C78.43	(2005) Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
NEMA C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Rev thru Feb 2006) Standard for Safety High-Intensity-Discharge Lamp Ballasts
UL 1598	(2004; Rev thru May 2006) Luminaires
UL 773	(1995; Rev thru Mar 2002) Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2006) Nonindustrial Photoelectric Switches for Lighting Control

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Groundline section is that portion between 305 mm above and 610 mm below the groundline.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Luminaire drawings; G,

Poles; G,

SD-03 Product Data

Environmental Data

Energy Efficiency

Luminaires; G,

Lamps; G,

Ballasts; G,

Lighting contactor; G,

Time switch; G,

Photocell switch; G,

Wooden poles; G,

Brackets

SD-04 Samples

Luminaires; G,

Submit one sample of each luminaire type, complete with lamp and ballast. Sample will be returned to the Contractor for installation in the project work.

SD-05 Design Data

Design Data for luminaires; G,

1.4 QUALITY ASSURANCE

1.4.1 Drawing Requirements

1.4.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

1.4.1.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS-4, pole deflection, pole class, and other applicable information.

1.4.2 Design Data for Luminaires

a. Distribution data according to IESNA classification type as defined in IESNA HB-9.

b. Computerized horizontal illumination levels in lux at ground level, taken every 3050 mm. Include average maintained lux level and maximum and minimum ratio.

c. Amount of shielding on luminaires.

1.4.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 Metal-Halide Lamps

Provide luminaires with tempered glass lens.

a. Double-ended, 70 watt, conforming to NEMA C78.1381

b. Single-ended, wattage as indicated, conforming to NEMA C78.43

Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

    1. 150-399 watts: minimum 41 LER for closed fixture

b. Upward efficiency of 1%-10%

    1. 150-399 watts: minimum 56 LER for closed fixture

c. Upward efficiency greater than 20%

    1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and NEMA C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90%). Provide single-lamp

ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 220 volts ac, 50 Hz with single-throw contacts designed to fail to the ON position. Switch shall turn on at or below 32 lux and off at 43 to 107 lux. A time delay shall prevent accidental switching from transient light sources.

a. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a fixture mounted, locking-type receptacle conforming to IEEE C136.10 and rated 1800 VA, minimum.

b. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

c. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

d. Integral to the luminaire, rated 1000 VA, minimum.

2.4 POLES

Provide poles designed for wind loading of 161 km/hr determined in accordance with AASHTO LTS-4 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors.Poles shall have oval-shaped handhole having a minimum clear opening of 65 by 130 mm. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

2.5 BRACKETS AND SUPPORTS

NEMA C136.3, NEMA C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 31.75 mm aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 7320 mm above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.6 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 344.5 MPa (50,000 psi); the top 305 mm of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-8), tube configuration, base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (rapid start) for fluorescent and luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.8 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.

3.1.2 Grounding

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.3 Field Applied Painting

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

-- End of Section --

SECTION 27 51 16

PUBLIC ADDRESS SYSTEM
04/06

PART 1 GENERAL

1.1 REFERENCES

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

CONSUMER ELECTRONICS ASSOCIATION (CEA)

CEA-310-E	(2005) Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2006) Surge Protective Devices

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

Detail Drawings; G

Detail drawings as specified.

SD-03 Product Data

Spare Parts

Spare parts data for each different item of material and equipment specified.

SD-06 Test Reports

Approved Test Procedures; G

Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step-by-step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

Acceptance Tests

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

SD-07 Certificates

Components

Copies of current approvals or listings issued by UL, or other nationally recognized testing laboratory for all components.

1.3 SYSTEM DESCRIPTION

The public address system shall consist of an exterior cluster mounted speakers, amplifiers, mixers, microphones, speakers, cabling, and ancillary components required to meet the required system configuration and operation.

1.3.1 Detail Drawings

The Contractor shall submit detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical speakers. The Contractor shall check the layout based on the actual speakers to be installed and make necessary revisions in the detail drawings. Detail drawings shall also contain complete point to point wiring, schematic diagrams and other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.3.2 Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

1.4 DELIVERY AND STORAGE

Equipment placed in storage until installation shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.5 VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancies before performing the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products, and shall essentially duplicate material and equipment that have been in satisfactory use at least 2 years. All components used in the system shall be commercial designs that comply with the requirements specified.

2.1.1 Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.2 Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalog number, and serial number on a plate secured to the equipment.

2.2 MIXER-PREAMPLIFIER

Mixer-preamplifier shall as a minimum conform to the following specifications:

Rated Output:	18 dB
Frequency Response:	Plus or Minus 1 dB, 20 - 20,000 Hz
Distortion:	Less than 0.5 percent, 20 - 20,000 Hz
Signal to noise:	Output Volumn Min 90 dB Output Volumn Max 61 dB
Inputs:	5 independent balanced low- impedance transformer-isolated
Input Sensitivity:	Microphone - 58 dB
Input Channel Isolation:	1,2:0 BV, 600 ohm
Tone Controls:	Plus or Minus 12 dB range at 50 and 15,000 Hz
Power Requirement:	220 Vac 50 Hz

2.3 POWER AMPLIFIERS

Power amplifiers as a minimum conform to the following specifications:

Rated power output:	250 watts RMS
Frequency Response:	Plus or Minus 3 dB, 20-20,000 Hz
Distortion:	Less than 1 percent at RPO, 600-13,000 Hz
Input Impedance:	50 k ohm unbalanced
Output Impedance:	Balanced 8 ohms
Output voltage:	25 and 70.7 volts
Power Requirement:	220 Vac 50 Hz

2.4 MICROPHONE INPUT MODULES

Microphone input modules shall as a minimum conform to the following specifications:

Rated Outputs:	0.25 volts into 10,000 ohms 1.0 volts into 10,000 ohms
Frequency Response:	Plus or Minus 2 dB, 20 - 20,000 Hz
Distortion:	Less than 0.5 percent 20 - 20,000 Hz
Inputs:	4 transformer - coupled balanced 150 ohm
Input Sensitivity:	0.003 volts
Input Channel Isolation:	70 dB minimum

2.5 MICROPHONES

2.5.1 Desk Microphone

Microphones shall as a minimum conform to the following specifications:

Element:	Dynamic
Pattern:	Cardioid
Frequency Response:	50 - 12,000 Hz
Impedance:	Low impedance mic (150-400 ohms)
Front-to-back Ratio:	20 dB
Selector switches:	Push to talk bar in base with locking lever

2.5.2 Microphone Jack

Each outlet for microphones shall consist of a standard outlet box, flush-mounted, and fitted with a three-pole, polarized, locking-type, female microphone jack and a corrosion resistant-steel device plate.

2.6 LOUDSPEAKERS

2.6.1 Voice Range Horn System

The horns shall as a minimum conform to the following specifications:

Application:	Outdoor Weatherproof
Frequency Response:	400 - 4700 Hz
Power Taps:	70 volt line - .9, 1.8, 3.8, 7.5, and 15 watts
Impedance:	5000, 2500, 1300, 670, 330, 90, and 45 ohms
Power Rating:	Normal - 75 watts Peak - 120 watts
Dispersion:	50 degrees Horz 40 degrees Vert
Signal Processing	400 Hz high pass filter
Drivers	Ferro fluid-cooled
Input Connection	2.5 MM^2, 2/C, 13M, sjow cable thru gland nut
Enclosure	Fiberglass

2.6.2 Cluster Mounted Speakers

Furnish eight (8) cluster mounted speakers mounted on a pole with stainless steel speaker mounting brackets. See plans for general arrangement of installation. Aim speakers to cover all areas within the compound.

2.7 CABLES

2.7.1 Speaker Cable

Cables shall be of the gauge required depending upon the cable run length. In no case shall cable be used which is smaller than $2.5MM^2$. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. The jacket thickness shall be 0.5 mm minimum.

2.7.2 Microphone Cable

Cable conductor shall be stranded copper $6MM^2$. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. Cable shall be shielded 100% of aluminum polyester foil with a bare $.5MM^2$ stranded soft copper drain conductor. The jacket thickness shall be 0.5 mm minimum.

2.8 TERMINALS

Terminals shall be solderless, tool-crimped pressure type.

2.9 SURGE PROTECTION

2.9.1 SIGNAL SURGE PROTECTION

Major components of the system shall have internal protection circuits which protects the component from mismatched loads, direct current, and shorted output lines. Communication cables/conductors shall have surge protection installed at each point where it exits or enters a building.

2.10 WALL CABINET

Furnish a series 27M wall cabinet for the equipment specified. Cabinet shall be vented and provided with hinged locking door.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out-of-doors or subject to inclement conditions shall be weatherproofed.

3.1.1 Wiring

Wiring shall be installed in rigid steel conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Wiring for microphone, grounding, line level, speaker and power cables shall be isolated from each other by physical isolation and metallic shielding. Shielding shall be terminated at only one end.

3.2 GROUNDING

All grounding practices shall comply with NFPA 70. Equipment shall be grounded to the serving panelboard ground bus through a green grounding conductor. Metallic conduits serving the equipment shall be isolated on the equipment end with an insulating bushing to prevent noise from being transferred to the circuit. Equipment racks shall be grounded to the panelboard ground bus utilizing a $10MM^2$ conductor. Grounding conductor shall be terminated to the rack using connector suitable for that purpose.

3.3 ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Contracting Officer 14 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Contracting Officer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or nondesignated units.

3.4 TRAINING

The Contractor shall conduct a training course for 6 members of the operating and maintenance staff as designated by the Contracting Officer. The training course will be given at the installation during normal working hours for a total of 3 hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to the start of the training course.

-- End of Section --

SECTION 28 31 64.00 10

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 2001) Audible Emergency Evacuation Signal (ASA 96)

FM GLOBAL (FM)

FM P7825a	(2005) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221	(2006; Errata 2006) Installation, Maintenance and Use of Emergency Services Communications Systems
NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 72	(2006) National Fire Alarm Code
NFPA 90A	(2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; Rev thru Jun 2006) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 268	(2006) Standard for Smoke Detectors for Fire Alarm Signaling Systems
UL 268A	(1998; Rev thru Apr 2006) Smoke Detectors for Duct Application
UL 38	(2005) Standard for Signaling Boxes for Fire Alarm Systems

UL 464	(2003; Rev thru Oct 2003) Standard for Audible Signal Appliances
UL 521	(1999; Rev thru Jul 2005) Heat Detectors for Fire Protective Signaling Systems
UL 6	(2004e13) Standard for Electrical Rigid Metal Conduit-Steel
UL 797	(2004) Standard for Electrical Metallic Tubing -- Steel
UL 864	(2003; Rev thru Mar 2006) Control Units and Accessories for Fire Alarm Systems

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

Detail Drawings

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, as specified.

SD-03 Product Data

Storage Batteries

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Low Battery Voltage

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G

Technical data which relates to computer software.

Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the

system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: Fire Alarm Technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.3.8 Detail Drawings

The Contractor shall submit detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style B, to signal line circuits (SLC), Style 4, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Y in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors.

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound

until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.

i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

l. The fire alarm control panel shall monitor and control the fire sprinkler system, or other fire protection extinguishing system.

m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

n. Zones for IDC shall be arranged as indicated on the contract drawings.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of a signal over the station fire reporting system. The signal shall be common for any device.

b. Visual indications of the alarmed devices on the fire alarm control panel display.

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

d. Deactivation of the air handling units serving the alarmed area.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger. Furnish one (1) set of backup storage batteries.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power,

startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.1.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.2 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.1.3 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style B initiating device circuits. The system shell be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm

control panel. Provide spare battery of same capacity for each fire alarm panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on surfacemounted outlet boxes. Manual stations shall be mounted at 1220 mm. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature. Heat detector spacing shall be rated in accordance with UL 521.

2.5.1.1 Fixed Temperature Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be designed to detect high heat. The detectors shall have a specific temperature setting of 57.2 degrees C. The UL 521 test rating for the fixed temperature detectors shall be rated for 4.57 by 4.57 m.

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections.

2.5.2.1 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 1.83 m and those mounted below 1.83 m that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.6 NOTIFICATION APPLIANCES

2.6.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted single grille and vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 3.05 m. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible

notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 220 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 4 addressable systems.

2.7.3 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than

two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm nor more than 2000 mm above the finished floor. Manually operable controls shall be between 900 and 1100 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm from any part of any lighting fixture. Detectors shall be located at least 900 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, sway bracing shall be provided.

3.1.5 Notification Appliances

Notification appliances shall be mounted 2003 mm above the finished floor or 150 mm below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault.

k. Short circuit faults.

l. Stray voltage.

m. Loop resistance.

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --

SECTION 31 00 00

EARTHWORK
07/06

PART 1 GENERAL

The contractor will provide all necessary site grading to establish the approximate grades indicated on the conteptual site plans unless otherwise approved by the Contracting Officer. Work will include providing adequate drainage so that no areas will be flooded due to a rainfall of a 10-year frequency. Grading and drainage of the area should be compatable with the existing terrain. Building floor elevations shall be a minimum of 150 mm above grade and slope away from the building on all sides at a minimum of 5 percent for 3 meters.

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 T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 224	(2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(2004) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002e1) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-203	(Rev C; Notice 2) Paper, Kraft, Untreated

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL-ML. Satisfactory materials for grading comprise stones less than 200 mm, except for fill material for pavement and building areas which comprise stones less than 75 mm in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include trash; refuse; man-made fills and backfills containing debris from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 19.0 mm sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 19.0 mm sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

For soils that are too coarse for testing by any of the methods listed above, compaction will be based on nonmovement of the material under the compaction equipment and a specified number of passes of the compaction equipment.

1.2.5 Topsoil

Material suitable for topsoils obtained from onsite and offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 25 mm diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7. Topsoil shall contain 5 to 10 percent organic matter as defined in Section 32 92 19.

1.2.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock". These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.8 Unstable Material

Unstable material are too wet for compaction and are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.9 Select Granular Material

Select granular material consisting of free draining materials classified as GW, GP, SW, SP, by ASTM D 2487 where indicated. Material gradation and minimum coefficient of permeability determined in accordance with ASTM D 2434 shall correspond with design requirements for the application specified.

1.2.10 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 30 and liquid limit exceeding 50 percent when tested in accordance with ASTM D 4318.

1.2.11 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible materials are clean coarse aggregates having less than 5 percent passing the 0.075 mm size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.3 MEASUREMENT

1.3.1 Excavation

Excavation will be unclassified. The unit of measurement for excavation and borrow will be the cubic meter, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered by Section 31 23 00.00 20), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

1.3.2 Topsoil Requirements

Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation.

1.3.3 Select Granular Material

Measure select granular material in place as the actual cubic meters replacing wet or unstable material in trench bottoms within the limits shown

in authorized overdepth areas. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

1.4 PAYMENT

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.4.1 Excavation

Excavation will be paid for at the contract unit prices per cubic meter for excavation.

1.4.2 Select Granular Material

Select granular material will be paid for at the contract unit prices per cubic meter for select granular material.

1.5 SUBMITTALS

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

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan; G

Dewatering Work Plan; G

Blasting; G

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G
Rock Excavation
Opening of any Excavation or Borrow Pit

Procedure and location for disposal of unused satisfactory material.
Proposed source of borrow material.

Notification of encountering rock in the project.
Advance notice on the opening of excavation or borrow areas.

SD-06 Test Reports

Testing
Borrow Site Testing; G

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

1.6 SUBSURFACE DATA

The contractor shall confirm subsurface conditions and parameters necessary for the work by geotechnical investigation.

1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.8 BLASTING

Perform blasting in accordance with EM 385-1-1 and in conformance with Federal, State, and local safety regulations. The Contractor shall submit a Blasting Plan, prepared and sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Provide blasting mats and use the non-electric blasting caps. Obtain written approval prior to performing any blasting and notify the Contracting Officer 24 hours prior to blasting. Include provisions for storing, handling and transporting explosives as well as for the blasting operations in the plan. The Contractor is responsible for damage caused by blasting operations.

1.9 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 100 mm. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations needed to construct the site as indicated. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations required. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity. Provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.3 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 0.9 m of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.

3.2.4 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to utilities in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within 600 mm of utilities or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from approved sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor is responsible for notifying the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory, unsatisfactory and wasted materials as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.7 GROUND SURFACE PREPARATION

3.7.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 150 mm before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 150 mm, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 300 mm and compact it as specified for the adjacent fill.

3.7.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removed from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific

written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use durable coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.9 EMBANKMENTS

3.9.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. Place the material in successive horizontal layers of loose material not more than 300 mm in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum dry density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9.2 Rock Embankments

Construct rock embankments from material classified as rock excavation, as defined above, placed in successive horizontal layers of loose material not more than 900 mm in depth. Do not use pieces of rock larger than 900 mm in the greatest dimension. Spread each layer of material uniformly, completely saturate, and compact. Place rock so larger pieces are evenly distributed and voids are filled as completely as possible. Adequately bond each successive layer of material to the material on which it is placed. Finish compaction with vibratory compactors, heavy rubber-tired rollers or steel-wheeled rollers weighing at least 9 metric tons. In embankments on which pavements are to be constructed, do not use rock above a point 900 mm below the surface of the pavement.

3.10 SUBGRADE PREPARATION

3.10.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Proof roll the subgrade with six passes of a dump truck loaded with 6 cubic meters of soil or a 13.6 metric tonpneumatic-tired roller. Operate the roller or truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the

presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with properly compacted satisfactory material.

3.10.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 150 mm below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, do not show deviations for the surface of the subgrade for roadways greater than 13 mm when tested with a 4 m straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 13 mm from the established grade and cross section.

3.10.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum dry density.

3.10.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percent of the laboratory maximum dry density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 203 mm of subgrade.

3.10.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percent of the laboratory maximum dry density for the full depth of the shoulder.

3.11 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain.

3.12 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the required lines, grades, and cross sections or elevations. Provide the degree of finish for graded areas within 30 mm of the required grades and elevations except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.12.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do no disturb the finished subgrade by traffic or other operation. The Contractor is responsible for protecting and maintaining the finsihed subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.12.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.12.3 Grading In and Around Structures

Construct areas within 3 m of each building and structure line true-to-grade, shape to drain and in accordance with these specifications. Maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.13 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 50 mm depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 102 mm and grade to the required elevations and slopes. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from approved offsite areas.

3.14 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, check the calibration curves and adjust using only the sand cone method as

described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil to determine the moisture content of the soil when using this method ASTM D 3017. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D 3017; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D 2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.14.1 In-Place Densities

a. One test per 465 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 95 square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.14.2 Check Tests on In-Place Densities

If ASTM D 2922 is used, check in-place densities by ASTM D 1556 as directed by the Contracting Officer.

3.14.3 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.14.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 1910 cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.14.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.15 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property as directed by the Contracting Officer.

-- End of Section --

SECTION 31 05 19

GEOTEXTILE
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 4354	(1999; R 2004) Sampling of Geosynthetics for Testing
ASTM D 4355	(2005) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

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

Thread

A minimum of 7 days prior to scheduled use, proposed thread type for sewn seams along with data sheets showing the physical properties of the thread.

Manufacturing Quality Control Sampling and Testing

A minimum of 7 days prior to scheduled use, manufacturer's quality control manual.

SD-04 Samples

Quality Assurance Samples and Tests

Samples for quality assurance testing; 7 days shall be allotted in the schedule to allow for testing.

SD-07 Certificates

Geotextile

A minimum of 7 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.3.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 71 degrees C, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.3.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be the type and class required for the intended application and shall exhibit properties conforming to design requirements. Geotextile shall be a pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Minimum average roll properties shall be specified in accordance with ASTM D 4759 and shall include the properties listed below. Where applicable, property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the design requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the Contracting Officer and in accordance with ASTM D 4354, Procedure B. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile at a frequency of one per 10,000 square meters. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 1 meter long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The Contractor shall provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 31 00 00.

3.2.2 Placement

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 300 mm at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn on all slopes steeper than 1 vertical on 4 horizontal. The stitch type used shall be a 401 locking

chain stitch or as recommended by the manufacturer. For factory seams which are sewn, the Contractor shall provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided. Quality Assurance seam samples shall be provided to the Government at the request of the Contracting Officer. Seam strength shall meet the minimum requirements. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 450 mm of overlap.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 300 mm beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover material shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, cover material shall be placed from the bottom of the slope upward. Cover material shall not be dropped onto the geotextile from a height greater than 1 m. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 50 kPa shall be used to place the first lift over the geotextile. A minimum of 300 mm of cover material shall be maintained between full-scale construction equipment and the geotextile. Equipment placing cover material shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 2.2 m/s.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
04/06

PART 1 GENERAL

1.1 SUBMITTALS

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

SD-03 Product Data

Nonsaleable Materials; G

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

SD-04 Samples

Tree wound paint

Herbicide

Submit samples in cans with manufacturer's label.

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to

existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Contracting Officer in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 40 mm or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 40 mm in diameter shall be painted with an approved tree-wound paint.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Prune trees designated to be left standing within the cleared areas of dead branches 38 mm or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 32 mm in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

All timber, limbs, tops, stumps, and debris shall be cleared and disposed of by the Contractor as specified.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of in the designated waste disposal area outside the limits of Government-controlled land at the Contractor's responsibility, or by burning, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed. Refuse to be burned shall be burned at specified locations and in a manner to prevent damage to existing structures and appurtenances, construction in progress, trees, and other vegetation. The Contractor shall be responsible for compliance with all Federal and State laws and regulations and with reasonable practice relative to the building of fires. Burning or other disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND BACKFILLING FOR UTILITIES AND STRUCTURES
04/06

PART 1 GENERAL

This work shall consist of excavation/trenching, and furnishing and placement of bedding and backfilling material associated with the installation of drainage pipes and structure foundations. The work also shall include furnishing, placing and removal of sheeting and shoring (if required), pumping and bailing, and all incidentals necessary to complete the work required by this section. This section shall be coordinated with requirements of Secrtion 31 00 00, EARTHWORK.

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2005) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(1998; R 2002) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2003) Standard Specification for Concrete Aggregates

ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1883	(2005) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3786	(2006) Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 422	(1963; R 2002e1) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4355	(2005) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1909	(Basic Notice 1; Canc. Notice 2) Fertilizer
FS A-A-203	(Rev C; Notice 2) Paper, Kraft, Untreated

1.2 DEFINITIONS

1.2.1 Degree of Compaction

As defined in Specification Section 31 00 00.

1.2.2 Hard Materials

As defined in Specification Section 31 00 00.

1.2.3 Rock

As defined in Specification Section 31 00 00.

1.3 SUBMITTALS

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

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan

Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G

Fill and backfill test

Select material test

Density tests

Moisture Content Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 QUALITY ASSURANCE

1.5.1 Shoring and Sheeting Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

1.5.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.5.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to utilities in accordance with procedures outlined by the utility company. Excavation made with power-driven equipment is not permitted within 600 mm of known utilities or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials for Use as Pipe Bedding and Backfill

Any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location. Grain size determination shall be made by the contractor in conformance with ASTM C 117, ASTM C 136, and ASTM D 422

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75 mm. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

As defined in Specification Section 31 00 00.

2.1.5 Backfill and Fill Material

As defined in Specification Section 31 00 00.

2.1.6 Select granular Material

As defined in Specification Section 31 00 00.

2.1.7 Topsoil

Topsoil shall be as defined in Specification Section 31 00 00.

2.2 PIPE BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 1557 maximum dry density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 6 to 40 mm, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 40 mm, including various graded sands and gravels containing small

percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2.3 RIP-RAP MATERIALS

Provide bedding material or geotextile and rock conforming to these requirements.

2.3.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 50 mm. Compose material of tough, durable particles. Allow fines passing the 75 micrometers standard sieve with a plasticity index less than six.

2.3.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments that are well graded and sized to prevent movement during the design storm event.

2.4 SEWAGE ABSORPTION TRENCHES

2.4.1 Porous Fill

Backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 65 mm sieve and zero percent passes the 12.5 mm sieve and conforming to the gradation requirements for coarse aggregate in ASTM C 33.

2.4.2 Cover

Geotextile conforming to Specification Section 31 05 19 or a layer of straw at least 50 mm thick as indicated.

2.5 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.6 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems

2.6.1 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.10 mm. Tape shall have a minimum strength of 10.3 MPa lengthwise and 8.6 MPa crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring, bracing, cribbing, trench boxes, underpinning, and sheeting where indicated. In addition to Section 25 A and B of EM 385-1-1 and other requirements set forth in this contract, include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.2 Drainage and Dewatering

Drainage and dewatering shall be in accordance with Specification Section 31 00 00.

3.1.3 Underground Utilities

The Contractor shall physically verify the location and elevation of the existing utilities prior to starting construction.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Clearing and gubbing shall be in accordance with Specification Section 31 00 00.

3.2.2 Stripping

Strip suitable topsoil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted or shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions required. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 95 percent of ASTM D 1557 maximum dry density. Unless specified otherwise, refill excavations cut below indicated depth with satisfactory material and compact to 95 percent of ASTM D 1557 maximum dry density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 150 mm below the bottom of the pipe.

3.3.2 Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.3.3 Hard Material and Rock Excavation

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.4 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Specification Section 31 00 00.

3.3.5 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. All surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Backfill and Fill Material Placement

Place in 150 mm lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.2 Select Granular Material Placement

Place in 150 mm lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.4.3 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade and shall include

backfill for outside grease interceptors. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.4.4 Porous Fill Placement

Place in 100 mm lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.4.5 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 150 mm lifts to top of trench and in 150 mm lifts to 300 mm over pipe outside structures and paved areas.

3.5 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.6 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 300 mm below finished grade; under pavements and slabs, bury tape 150 mm below top of subgrade.

3.7 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.8 COMPACTION

Material placement and compaction shall be in accordance with Specification Section 31 00 00.

3.9 SPECIAL EARTHWORK REQUIREMENTS FOR SUBSURFACE DRAINS

Excavate to dimensions indicated. Place select granular material in 150 mm lifts and compact with mechanical, vibrating plate tampers or rammers until no further consolidation can be achieved. Compact backfill overlying the select granular material as specified for adjacent or overlying work.

3.9.1 Granular Backfill Using Geotextile

Where goetextile is needed to prevent piping of soil into the drain, install geotextile in trenches with smoothly graded sides and bottom, free of cavities or projecting rocks. Lay the fabric flat but not stretched and secure with anchor pins. Place geotextile so that drain water must pass through the cloth into the specified granular filter material. Overlap ends at least of 300 mm. Place backfill on geotextile in the direction of overlaps. Where fabric is damaged, place a new piece of geotextile over damaged area and overlap at least of 300 mm in every direction.

3.10 EARTHWORK REQUIREMENTS FOR SEWAGE ABSORPTION TRENCHES

Provide sewage absorption trench as indicated. Grade trenches uniformly downward to ends of laterals. Place porous fill around and over pipe as indicated. Take special care to prevent displacement of or damage to pipe or pit walls. Cover porous fill with geotextile as indicated before continuing with backfill for adjacent or overlying work.

3.11 RIP-RAP CONSTRUCTION

Construct rip-rap on bedding material or geotextile filter.

3.11.1 Preparation

Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 30 mm.

3.11.2 Filter Placement

If bedding material is used as the filter, spread the material uniformly to a thickness of at least 75 mm on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows. Place geotextile filter in accordance with Specification Section 31 00 00.

3.11.3 Stone Placement

Place rock for rip-rap on prepared filter material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12 FINISH OPERATIONS

3.12.1 Grading

Finish grades as indicated within 30 mm. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing

grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.12.2 Topsoil and Seed

Provide as specified in Section 32 92 19 SEEDING.

3.12.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.13 FIELD QUALITY CONTROL

3.13.1 Sampling

Take the number and size of samples required to perform the following tests.

3.13.2 Testing

Material testing shall be in accordance with Specification Section 31 00 00 except that in-place density testing shall be performed at a rate of one test per 15 m of trench per lift.

3.13.2.1 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.13.2.2 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216. Include moisture content test results in daily report.

-- End of Section --

SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

10/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1560	(2005e1) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D 1682	(1964; R 1975e1) Test for Breaking Load and Elongation of Textile Fabrics
ASTM D 1777	(1996; R 2002) Thickness of Textile Materials
ASTM D 2844	(2001e1) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 3776	(1996; R 2002) Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2001) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(2001e1) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4355	(2005) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(2005) Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

ASTM D 4632	(1991; R 2003) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(2001) pH of Soils
ASTM D 5035	(1995; R 2003) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(2002) Topsoil Used for Landscaping Purposes
ASTM D 5852	(2000) Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
ASTM D 648	(2006) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D 6629	(2001) Selection of Methods for Estimating Soil Loss by Erosion
ASTM D 698	(2000ae1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D 977	(2005) Emulsified Asphalt

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-01 Preconstruction Submittals

Work sequence schedule; G
Erosion control plan; G

SD-02 Shop Drawings

Erosion Control;G

Scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record

Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.

SD-03 Product Data

Manufacturer's literature including physical characteristics, application and installation instructions.

SD-07 Certificates

Fill Material
Mulch
Hydraulic Mulch
Geotextile Fabrics

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

For items listed in this section:

a. Certification of recycled content or,

b. Statement of recycled content.

c. Certification of origin including the name, address and telephone number of manufacturer.

Geosynthetic Binders
Synthetic Soil Binders

Certification for binders showing EPA registered uses, toxicity levels, and application hazards.

Installer's Qualification

The installer's company name and address; training and experience and or certification.

Recycled Plastic

Individual component and assembled unit structural integrity test; creep tolerance; deflection tolerance; and vertical load test results. Life-cycle durability.

Seed

Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

Asphalt Adhesive
Tackifier

Composition.

Wood By-Products

Composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material.

Wood Cellulose Fiber

Certification stating that wood components were obtained from managed forests.

SD-10 Operation and Maintenance Data

Maintenance Instructions

Instruction for year-round care of installed material. The Contractor shall include manufacturer supplied spare parts.

1.3 MEASUREMENT AND PAYMENT

No separate measurement and payment shall be made for Soil Surface Erosion Control measures.

1.4 DESCRIPTION OF WORK

The work consists of furnishing and installing temporary and permanent soil surface erosion control materials, including fine grading, blanketing, stapling, mulching and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work includes all necessary materials, labor, supervision and equipment for installation of a complete system.

1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Do not drop containers from trucks. Material shall be free of defects that would void required performance or warranty. Deliver geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.

a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls to provide identification sufficient for inventory and quality control purposes.

b. Seed shall be appropriate for the region and inspected upon arrival at the jobsite for quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

1.6 QUALITY ASSURANCE

1.6.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

1.7 TIME LIMITATIONS

Complete backfilling the openings in synthetic grid systems a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.8 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 PRODUCTS

2.1 BINDERS

2.1.1 Synthetic Soil Binders

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.1.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with ASTM D 1560, ASTM D 2844; and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.

2.2 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.2.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.2.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.2.3 Wood Cellulose Fiber

Wood cellulose fiber shall be 100 percent recycled material and shall not contain any growth or germination-inhibiting factors and shall be dyed with

non-toxic, biodegradable dye an appropriate color to facilitate placement during application. Composition on air-dry weight basis: a minimum 9 to a maximum 15 percent moisture, and between a minimum 4.5 to a maximum 6.0 pH.

2.2.4 Paper Fiber

Paper fiber mulch shall be 100 percent post-consumer recycled news print that is shredded for the purpose of mulching seed.

2.2.5 Shredded Bark

Locally shredded material shall be treated to retard the growth of mold and fungi.

2.2.6 Wood By-Products

Wood locally chipped or ground bark shall be treated to retard the growth of mold and fungi. Gradation: A maximum 50 mm wide by 100 mm long.

2.2.7 Coir

Coir shall be manufactured from 100 percent coconut fiber cured in fresh water for a minimum of 6 months.

2.2.8 Asphalt Adhesive

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1; and cutback asphalt, conforming to ASTM D 2028, Designation RC-70.

2.2.9 Mulch Control Netting and Filter Fabric

Mulch control netting and filter fabric may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:

a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 0.8 kN.

b. Minimum Puncture (TF 25 #4/ASTM D 3787), 0.52 MPa in the weakest direction.

c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size).

d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 0.22 kN.

2.2.10 Hydraulic Mulch

Hydraulic mulch shall be made of 100 percent recycled material or virgin aspen wood fibers. Wood shall be naturally air-dried to a moisture content of 10.0 percent, plus or minus 3.0 percent. A minimum of 50 percent of the fibers shall be equal to or greater than 5 mm in length and a minimum of 75 percent of the fibers shall be retained on a 28 mesh screen. No reprocessed paper fibers shall be included in the hydraulic mulch. Hydraulic mulch shall have the following mixture characteristics:

CHARACTERISTIC (typical)	VALUE
pH	5.4 ± 0.1

Organic Matter (oven dried basis),	percent 99.3 within ± 0.2
Inorganic Ash (oven dried basis),	percent 0.7 within ± 0.2
Water Holding Capacity,	percent 1,401

2.2.11 Tackifier

Tackifier shall be a blended polyacrylimide material with non-ionic galactomannan of Gramineae endosperm in powder and crystalline form with molecular weights over 250,000.

2.2.12 Dye

Dye shall be a water-activated, green color. Pre-package dye in water dissolvable packets in the hydraulic mulch.

2.3 GEOTEXTILE FABRICS

Geotextile fabrics shall be woven of polyester or polypropylene filaments formed into a stable network so that the filaments retain their relative position to each other. Sewn seams shall have strength equal to or greater than the geotextile itself. Install fabric to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight	264 g/m^2	ASTM D 3776
Thickness	0.635 mm	ASTM D 1777
Permeability	0.12 cm/sec	ASTM D 4491
Abrasion Resistance,	58 percent X	
Type (percent strength retained)	81 percent	ASTM D 3884
Tensile Grab Strength	1,467 N X 1, 933 N	ASTM D 4632
Grab Elongation	15percent X 20percent	ASTM D 4632
Burst Strength	5,510 kN/m^2	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

2.4 EROSION CONTROL BLANKETS

2.4.1 Erosion Control Blankets Type I

Use Type I blankets for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blankets shall be a machine-produced mat of 100% straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. cover the blanket on the top side with a photodegradable polypropylene netting having an approximate 13 by 13 mm mesh and be sewn

together on a maximum 40 mm centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.27 kg/m^2 weight
Netting	One side only, lightweight photodegradable with approximately 8.0 kg/100 m^2 weight.
Thread	Degradable

Note 1: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.5 WATER

Unless otherwise directed, water is the responsibility of the Contractor.

PART 3 EXECUTION

3.1 CONDITIONS

Perform erosion control operations under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, submit a revised construction schedule for approval. Do not apply erosion control materials in adverse weather conditions which could affect their performance.

3.1.1 Placement of Erosion Control Blankets

Before placing the erosion control blankets, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Vehicles shall not be permitted directly on the blankets.

3.2 SITE PREPARATION

3.2.1 Soil Test

Test soil in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop drawing shall be submitted indicating the corrective measures.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high-visibility fencing along the dripline. Mitigate damage to existing trees at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, submit shop drawings showing proposed adjustments to placement of erosion control material for approval.

3.3 INSTALLATION

3.3.1 Synthetic Binders

Apply synthetic binders heaviest at edges of areas and at crests of ridges and banks to prevent displacement. Apply binders to the remainder of the area evenly at the rate recommended by the manufacturer.

3.3.2 Mulch Control Netting

Netting may be stapled over mulch according to manufacturer's recommendations.

3.3.3 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.4 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 666 to 866 L/hectare. Do no completely exclude sunlight from penetrating to the ground surface.

3.3.5 Non-Asphaltic Tackifier

Apply hydrophilic colloid at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. Apply a uniform mixture over the area.

3.3.6 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 666 to 866 L/hectare, using power mulch equipment equipped with suitable asphalt pump and nozzle. Apply the adhesive-coated mulch evenly over the surface. Do not completely exclude sunlight from penetrating to the ground surface.

3.3.7 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Apply wood cellulose fiber, paper fiber, or recycled paper as part of the hydraulic mulch operation.

3.3.8 Hydraulic Mulch Application

3.3.8.1 Unseeded Area

Install hydraulic mulch as indicated and in accordance with manufacturer's recommendations. Mix hydraulic mulch with water at the rate recommended by the manufacturer for the area to be covered. Mixing shall be done in equipment manufactured specifically for hydraulic mulching work, including an agitator in the mixing tank to keep the mulch evenly disbursed.

3.3.8.2 Seeded Area

For drill or broadcast seeded areas, apply hydraulic mulch evenly at an approved rate.

3.3.9 Erosion Control Blankets

a. Install erosion control blankets as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as shown on drawings.

b. Orient erosion control blankets in vertical strips and anchored with staples, as indicated. Abut adjacent strips to allow for installation of a common row of staples. Overlap horizontal joints between erosion control blankets sufficiently to accommodate a common row of staples with the uphill end on top.

c. Where exposed to overland sheet flow, locate a trench at the uphill termination. Staple the erosion control blanket to the bottom of the trench. Backfill and compact the trench as required.

d. Where terminating in a channel containing an installed blanket, the erosion control blanket shall overlap installed blanket sufficiently to accommodate a common row of staples.

3.4 CLEAN-UP

Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed. .

3.5 WATERING SEED

Apply water to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 25 mm depth. Prevent run-off and puddling. Do no drive watering trucks over turf areas, unless otherwise directed. Prevent watering of other adjacent areas or plant material.

3.6 MAINTENANCE RECORD

Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.6.2 Maintenance Instructions

Furnish written instructions containing drawings and other necessary information, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

3.6.3 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Remove material not meeting the required performance as a result of placement, seaming or patching from the site. Replace the unacceptable material at no additional cost to the Government.

-- End of Section --

SECTION 32 15 00

AGGREGATE SURFACE COURSE
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3740	(2004a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 422	(1963; R 2002e1) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D 75	(2003) Standard Practice for Sampling Aggregates
ASTM E 11	(2004) Wire Cloth and Sieves for Testing Purposes

1.2 UNIT PRICES

1.2.1 Measurement

The quantity of aggregate surface course used for construction of parking areas and aggrgegate sidewalks completed and accepted as determined by the Contracting Officer shall be measured in cubic meters.

1.2.2 Payment

Quantities of aggregate surface course for parking areas and sidewalks, as measured above, will be paid for at the respective contract unit prices. Payment will constitute full compensation for the construction and completion of the aggregate surface course, including furnishing all labor and incidentals necessary to complete the work required by this section.

1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated herein as present laboratory maximum density.

1.4 SUBMITTALS

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

SD-03 Product Data

Equipment

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-06 Test Reports

Sampling and Testing

1.5 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to approval by the Contracting Officer before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.6 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to approval. If the Contractor elects to establish its own testing facilities, approval of such facilities will be based on compliance with ASTM D 3740. No work requiring testing will be permitted until the Contractor's facilities have been inspected and approved.

1.6.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.6.2 Testing

1.6.2.1 Gradation

Aggregate gradation shall be made in conformance with ASTM C 117, ASTM C 136, and ASTM D 422. Sieves shall conform to ASTM E 11.

1.6.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.6.3 Approval of Materials

The source of the material to be used for producing aggregates shall be selected 14 days prior to the time the material will be required in the work. Approval of sources not already approved by the Corps of Engineers will be based on an inspection by the Contracting Officer. Tentative approval of materials will be based on appropriate test results on the aggregate source. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted surface course.

1.7 WEATHER LIMITATIONS

Aggregate surface courses shall not be constructed when the ambient temperatures is below 2 degrees C and on subgrades that are frozen or contain frost. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor shall be responsible for

obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed.

2.1.1 Coarse Aggregates

The material retained on the 4.75 mm sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ASTM C 131. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the 4.75 mm sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements for Surface Courses

Gradation requirements specified in TABLE I shall apply to the completed aggregate surface. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION FOR AGGREGATE SURFACE COURSES

Sieve Designation	Parking or Road		Sidewalk	
	No. 1 or	No. 2	No. 3 or	No. 4
25.0 mm	100	100	100	100
9.5 mm	50-85	60-100	--	--
4.75 mm	35-65	50-85	55-100	70-100
2.00 mm	25-50	40-70	40-100	55-100
0.425 mm	15-30	24-45	20-50	30-70
0.075 mm	8-15	8-15	8-15	8-15

2.1.4 Gradation Requirements for Base Courses

The previous base course shall be of such nature that it can be compacted readiliy to a firm, stable base and shall conform to one of the following sizes:

TABLE II. GRADATION FOR AGGREGATE BASE COURSES

Sieves	Size Numbers		
	No. 1	No. 2	No. 3
50.0 mm	100	--	--

37.5 mm	70-100	100	--
25.0 mm	45-80	60-100	100
12.5 mm	30-60	30-65	40-70
4.75 mm	20-50	20-50	20-50
2.0 mm	15-40	15-40	15-40
425 micrometers	0-25	0-25	0-25

2.2 LIQUID LIMIT AND PLASTICITY INDEX REQUIREMENTS

The portion of the completed aggregate surface course passing the 0.425 mm sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specification requirements in the specified time limit. Upon completion of the work, the aggregate sources on Government property shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.2 STOCKPILING MATERIALS

Prior to stockpiling the material, the storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING COURSE SUBGRADE

The subgrade shall be cleaned of all foreign substances. At the time of surface course construction, the subgrade shall contain no frozen material. Ruts or soft yielding spots in the subgrade areas having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompacting. The completed subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor.

3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the material and a uniform optimum water content for compaction. The Contractor shall

make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

3.6 LAYER THICKNESS

The aggregate material shall be placed in layers of uniform thickness. When a compacted layer of 150 mm or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 150 mm is required, no layer shall exceed 150 mm nor be less than 75 mm when compacted.

3.7 COMPACTION

Each layer of the aggregate surface course shall be compacted with approval compaction equipment. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the Contracting Officer. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

3.8 PROOF ROLLING

Proof rolling of the areas designated shall be in addition to compaction specified above and shall consist of application of 30 coverages with a heavy rubber-tired roller having four tires abreast with each tire loaded to 13,600 kg and tires inflated to 1000 kPa. In the areas designated, proof rolling shall be applied to the top lift of layer on which surface course is laid and to each layer of the base course. Water content of the lift of the layer on which the surface course is placed and each layer of the aggregate surface course shall be maintained at optimum or at the percentage directed from the start of compaction to the completion of a proof rolling. Materials in the aggregate surface course or underlying materials indicated unacceptable by the proof rolling shall be removed and replaced, as directed, with acceptable materials.

3.9 SMOOTHNESS TEST

The surface of each layer shall not show any deviations in excess of 10 mm when tested with a 3 m straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by the Contractor by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.10 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 13 mm, plus or minus, of the thickness indicated on plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square meters of the aggregate surface course. The thickness measurement shall be made by test holes at least 75 mm in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 13 mm deficient in thickness, the Contractor, at no additional expense to the

Government, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed. Where the measured thickness of the aggregate surface course is more than 13 mm thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 13 mm. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 6 mm of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to the Government, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

3.11 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D 1556.

3.12 WEAR TEST

Wear tests shall be made in conformance with ASTM C 131.

3.13 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --

SECTION 32 31 13.00 20

CHAIN LINK FENCES AND GATES
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 116	(2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A 121	(2004) Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 176	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392	(2003) Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478	(1997; R 2002) Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A 491	(2003) Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 824	(2001) Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM D 4541	(2002) Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM F 1043	(2004) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(2004) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(2003) Industrial and Commercial Horizontal Slide Gates
ASTM F 626	(1996a; R 2003) Standard Specification for Fence Fittings
ASTM F 883	(2004) Padlocks
ASTM F 900	(2003) Industrial and Commercial Swing Gates

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Rev thru Dec 2006) Bullet-Resisting Equipment

1.2 SUBMITTALS

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

SD-07 Certificates

Chain Link Fence

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 1, zinc-coated galvanized steel wire with minimum coating weight of 370 grams of zinc per square meter of coated surface. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

As applicable and except as specified elsewhere, gates shall be in accordance with the following requirements, ASTM F 900 and/or ASTM F 1184. Gate shall be the type and configuration shown. Gate frames shall conform to strength

and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Except as specified otherwise, latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 SLIDING STEEL GATES

The manually operated, sliding steel gates at the ECPs shall consist of a heavy duty galvanized steel frame with painted steel panels blocking view. The gate shall meet requirements of UL 752. Gate shall have a high security slide bolt lock operable only from inside. The gate will be of cantilevered construction high with no hardware in the roadway. The height of the gate shall be a minimum of 2.1 m from the road surface to the top of the gate frame. The length shall close and protect a minimum 4 m clear opening. The maximum clear opening between the gate frame and end posts, between the bottom of the gate and finished grade, and between any grill work shall be 75 mm.

2.4 POSTS

2.4.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel hot dipped zinc coated galvanized welded pipe. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.5 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 42 mm, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished. Use rails only if/as shown.

2.6 WIRE

2.6.1 Tension Wire

Tension wire shall be Type I or Type II, Class 4 coating, in accordance with ASTM A 824.

2.7 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire support arms shall be the V arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Tie wires for attaching fabric to tension wire on high security fences shall be 1.6 mm stainless steel. The tie wires shall be a double loop and 165 mm in length. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.8 CONCRETE

ASTM C 94/C 94M, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.9 PADLOCKS

Padlocks shall conform to ASTM F 883, Type PO1, Options A, B, and G, Grade 6. EPB, Size 44 mm. All padlocks shall be keyed alike.

PART 3 EXECUTION

3.1 INSTALLATION

Fence and gates shall be installed as indicated and otherwise to the lines and grades indicated. Wall posts and line posts shall be spaced equidistant at intervals not exceeding 3 m. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

As applicable, post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities shall be eliminated to the extent necessary to maintain a 50 mm clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Post sizes shall be as shown on drawings. Post footings, where applicable, shall be no less that 250 mm in diameter and below the area's frost depth level usually not less that 800 mm. Posts shall be set plumb and in alignment. For posts set in ground, except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 457 mm in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 457 mm in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 25 mm greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm and shall be protected with drive caps when being set. Fence post rigidity shall be tested by applying a 222.4 newtons force on the post, perpendicular to the fabric, at 1.52 m above ground; post movement measured at the point where the force is applied shall be less than or equal to 19 mm from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

3.4.1 Top Rail

Top rail (if/as shown) shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

3.4.2 Bottom Rail

The bottom rail (if/as shown) shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m in height. A center brace or 2 diagonal truss rods shall be installed on 3.66 m fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 305 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 305 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the wall or ground or as shown. After the fabric installation is complete, the fabric shall be exercised by applying a 222 newtons push-pull force at the center of the fabric between posts; the use of a 133 newtons pull at the center of the panel shall cause fabric deflection of not more than 63.5 mm when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.8 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide or Lift gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.9 TOLERANCES

Posts shall be straight and plumb within a vertical tolerance of 6 millimeter after the fabric has been stretched. Fencing and gates shall be true to line with no more than 15 millimeter deviation from the established centerline between line posts. Defects shall be repaired as directed.

-- End of Section --

SECTION 32 92 19

SEEDING
10/06

PART 1 GENERAL

Areas not paved or surface with aggregate, including the soccer field (if provided), shall be seeded in accordance with this specification.

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 602	(2006) Agricultural Liming Materials
ASTM D 4427	(1992; R 2002e1) Peat Samples by Laboratory Testing
ASTM D 4972	(2001) pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 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

Proposed seed mixture and planting plan; G

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

State certification and approval for seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.4.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.4.2 Storage

1.4.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.4.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.4.2.3 Handling

Do not drop or dump materials from vehicles.

1.5 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.5.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 32 degrees Celsius.

1.6 TIME LIMITATIONS

1.6.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

Provide a seed mixture that is typical to the region. Planting dates also shall be typical to the region.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK and 31 23 00.00 20 EXCAVATION AND BACKFILLING FOR UTILITIES AND STRUCTURES.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.3 Composition

As specified in Section 31 00 00. Also, topsoil shall contain from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42.

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone, hydated lime containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 95,100 and percent, respectively.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427. Shred and granulate peat to pass a 12.5 mm mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

4.75 mm screen	95
2.36 mm screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 61 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 850 micrometers, 100 percent passing thru 970 micrometers screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 650 degrees C. Gradation: A minimum 90 percent shall pass a 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

10 percent available nitrogen
20 percent available phosphorus
10 percent available potassium

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the minimum percentages, by weight, of plant food nutrients specified above.

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contrain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based or wood-based hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to Specification Section 31 32 11.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 102 mm of topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer pH adjusters and soil conditioners into soil as needed by disking, harrowing, tilling or

other method approved by the Contracting Officer. Remove debris and stones larger than 19 mm in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method is unspecified but shall be typical to region.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 0.75 metric tons per hectare. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 666 to 866 liters per hectare. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.2.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 666 to 866 liters per hectare, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 134 kg per m for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 50 mm without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
10/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C504	(2006) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C606	(2004) Grooved and Shouldered Joints
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C800	(2005) Underground Service Line Valves and Fittings
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C905	(1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm)
AWWA C909	(2002) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 12 IN (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation
AWWA M9	(1995) Manual: Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250
ASME B16.15	(1985; R 2004) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2006) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(1998) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 563	(2004a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2006) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 746	(2003) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B 32	(2004) Standard Specification for Solder Metal
ASTM B 42	(2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM D 1599	(2005) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	(2006a) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and

	Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	(2002e1) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Standard for Gate Valves for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
UBPPA UNI-B-8	(2000) Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inch)

1.2 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will not be made under this section for excavation, trenching, or backfilling.

1.2.1 Measurement

The length of water lines to be paid for will be determined by measuring along the centerlines of the various sizes of pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting, from center of water distribution line to end of service connection, and from center of water distribution line to center of hydrant. No deduction will be made for the space occupied by valves or fittings.

1.2.2 Payment

Payment will be made for water lines at the contract unit price per linear meter for the various types and sizes of water lines, and will be full compensation for all pipes, joints, specials, and fittings, aggregate bedding and cover, trench backfill, tracer wire (for PVC pipe), polywrap (for ductile iron pipe), compaction, and concrete encasement (where required) complete in place. Payment for gate valves, valve boxes will be made per each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 100 through 300 mm diameter pipe sizes of ductile-iron or polyvinyl chloride (PVC) plastic pipe.

1.3.2 Water Service Lines

Provide water service lines or 19 mm, 25 mm, 38 mm, .175 mm diameter from water distribution main to building service at a point approximately 1.5 m from building. Water service lines shall be copper tubing or polyvinyl chloride (PVC) plastic pipe. Provide water service line appurtenances as specified.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control

approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection; G.

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining and coating

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, and valves free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC) pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, AWWA C151/A21.51, Thickness Class 25. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 200 (DR 14) with ast-iron-pipe-equivalent OD.

b. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4.

c. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 80 to 300 mm in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 1380 kPa, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair.

2.1.2.2 Gate Valves Aboveground Location

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-discorsolid-wedge gates and flanged ends, (2) AWWA C509 shall be nonrising stem type with flanged ends, and (3) UL 262 shall be inside-screw type, shall have double-disc or split-wedge type gate and flanged ends, and shall be designed for a hydraulic working pressure of 1380 kPa. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall be of one manufacturer.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of 1040 kPa. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Flanges shall be Class 125 conforming to ASME B16.1.

2.1.2.4 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met.

2.1.2.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.6 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used

and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 5 mm. The least diameter of the shaft of the box shall be 135 mm. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.7 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 2.5 mm in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, ASME B16.15, 825 kPa.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88M, Type K. Fittings for solder-type joint, ASME B16.18 or ASME B16.22; fittings for compression-type joint, ASME B16.26, flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Screw Joints: ASTM D 1785, Schedule 80. Fittings, ASTM D 2466 or ASTM D 2467. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 1120/PVC I; PVC 1220/PVC 12; PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564. Pipe couplings, when used shall be tested as required by ASTM D 2464.

b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting the requirements of 1.03 MPa (150 psi) working pressure, 1.38 MPa (200 psi) hydrostatic test pressure, unless otherwise shown or specified.

c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

   Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa (150 psi) working pressure and 1.38 MPa (200 psi) hydrostatic test pressure.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Length of goosenecks shall be in accordance with standard practice.

2.2.2.4 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Each box shall have a heavy coat of bituminous paint.

2.2.2.5 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Do not lay water line closer horizontally than 3.0 m from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 3.0 m on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 900 mm horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 600 mm above these sewer lines; when joints in the sewer line are closer than 900 mm horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines, fuel lines or electric wiring. Copper tubing shall not be installed in the same trench with ferrous piping materials. Where nonferrous metallic pipe, e.g. copper tubing, cross any ferrous piping, provide a minimum vertical separation of 300 mm between pipes.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 3.0 m horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 3.0 m, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 450 m above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 450 mm between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 450 mm between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 6.1 m, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20 "EXCAVATION AND FILL".

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into

trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 820 mm.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Penetrations

Pipe passing through walls and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.6 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing)for pipe anchorage. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 15 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage . Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 15 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Fittings: Install in accordance with AWWA C605.

3.1.2.3 Installation of Valves

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to the main by a corporation stop and gooseneck and install a service stop below the frostline. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

(1) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B 32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

(2) Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.5 Disinfection

Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and

provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3 Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper tubing joints (soldered, compression type, brazed), plastic pipe joints flanged joints and screwed joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 375 kPa greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 50 mm in diameter, hydrostatic test pressure shall be not less than 1400 kPa. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 16 15

WATER STORAGE STEEL TANKS HYDROPNEUMATIC AND ELEVATED DESIGN
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2002; Errata 2003) Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C504	(2006) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA D100	(2005) Welded Steel Tanks for Water Storage
AWWA D103	(1997) Factory-Coated Bolted Steel Tanks for Water Storage

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII	(2007) Boiler and Pressure Vessel Codes: Section VIII Rules for Construction of Pressure Vessels, Division 1
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 197/A 197M	(2000; R 2006) Standard Specification for Cupola Malleable Iron
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NSF INTERNATIONAL (NSF)

NSF 61	(2005; Addendum 2005) Drinking Water System Components - Health Effects

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS Guide 17.00	(1982; E 2004) Guide for Selecting Urethane Painting Systems
SSPC Paint 104	(1982; E 2004) Paint Specification No. 104 White or Tinted Alkyd Paint
SSPC Paint 21	(1982; E 2004) Paint Specification No. 21 White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss)
SSPC Paint 25	(1997; 2004e1) Paint

Specification No. 25 Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II

U.S. BUREAU OF RECLAMATION (BOR)

BOR Paint Mnl (1976) Paint Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-24441 (Rev C; Supp 1; Am 1) Paint, Epoxy-Polyamide

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

Tank Installation; GA

Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of steel, pipe, foundation, and concrete work and with details of the assembling of items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of welded joints referenced on the drawings shall be included.

SD-03 Product Data

Tank, Controls and Instrumnetation, Valves, and Piping; GA

The contractor shall provide manufacturer's standard catalog, installation manuals, operation and maintenace manuals, descriptive data and technical literature, performance charts and curves, and catalog cuts.

SD-06 Test Reports; GA

Each coating manufacturer's technical data, application instructions, Material Safety Data Sheets (MSDS), and certificate for compliance for VOC content.

The contractor shall provide the following: Six copies of each test containing the information described below (items 1-7) in bound letter-sized booklets, individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible. 1) The date the tests were performed. 2) A list of equipment used, with calibration certifications. 3) A copy of measurements taken. 4) The parameters to be verified. 5) The condition specified for the parameter. 6) the inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were

accomplished, that the procedures were conducted in compliance with the plans and specifications. 7) A description of adjustments performed.

Testing, Adjusting, and Balancing; GA

For all tanks, system controls and instrumentation, valves, and piping, the contractor shall provide the following:1)Two copies of the TAB schematic drawings and report forms, no later than 7 days prior to the start of TAB field measurements 2) A list of any related submittals no later than 7 days prior to the start of TAB field measurements 3) Proposed procedures for TAB, submitted with the TAB schematic drawings and report forms 4) Proposed date and time to begin system readiness check 5) Proposed date and time to begin field measurement, making adjustments, etc. for the TAB report, submiited with the system readiness check report 6) Proposed date and time to begin the TAB verification, submitted with the TAB report 7) A copy of completed checklists for each contract in the project scope, each signed by the contractor's representative 8) Two copies of completed TAB reports no later than 7 days after the execution of TAB signed by the contractor's representative.

SD-07 Certificates

General Requirements

Foundations

Certification by an independent third-party organization that all interior coating and materials that come in contact with the potable water comply with NSF 61.

A certificate signed by a registered professional engineer, providing the following information:

a. Description of the structural design loading conditions used for the design of entire tank including the foundation.

b. Description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design.

c. (Elevated Tanks) A statement verifying that the structural design has been checked by experienced engineers specializing in hydraulic structures.

d. (Elevated Tanks) A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and facbricating process as prescribed by applicable ACI and AWWA standards.

SD-10 Operation and Maintenance Data

Hydropneumatic Tank - Submit Data Package 3 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

1.3 GENERAL REQUIREMENTS

1.3.1 Design and Construction Standards

The design, fabrication, and erection of the elevated tank shall be in accordance with the applicable requirements of AWWA D100 or AWWA D103 except as modified herein. Earthquake design shall be as indicated. No additional thickness for corrosion allowance will be required. The elevated tank shall be designed for a basic wind speed in accordance with ASCE 7 or designed in accordance with AWWA D100 wind load design, whichever provides the greater pressure. The elevated tank shall be designed for a snow load of 1200 Pa.

1.3.2 Welding

Qualification of welding procedures, welders, and welding operators shall be in accordance with Section 8.2 of AWWA D100.

1.3.3 Design Requirements

The elevated tank shall have a storage capacity equal to one days storage as shown. The high-water level of tank shall be as determined by the Contractor. The range between high and low water levels shall be approximately 1-3 m. The top of straight side sheets, where a cone-shaped roof is furnished, shall not be less than 150 mm above the top of the overflow weir. The riser diameter not less than 150 mm. The tank may have an ellipsoidal bottom, with vertical side sheets and a cone shaped top, or shall be of an elliptical or oval design as approved. Other configurations will be considered provided they can be demonstrated to meet the design criteria specified herein. In the elliatical or oval design, the lower section of the roof may be used for water storage. The tower supporting the tank shall be constructed of structural shapes of the open type, or of tubular sections, to permit inspection and painting. The tower shall be thoroughly braced with horizontal struts and diagonal ties. The tower columns may be vertical or inclined as the design may require. Main column splices shall be as few as possible and shall be located as near as practicable to the intersection of the centerline of the struts. Splice plates shall be welded so as to hold the members in line and transmit any tension or shearing stresses to which the members may be subjected. The connections of the tank, with the columns shall be made to distribute the load properly over the column sections and over the shell of the tank. Around the bottom of the tank a balcony meeting the requirements of Section 4.7.2 of AWWA D100 and conforming to all local laws or regulations shall be provided. Balcony floor plates shall be at least 6 mm thick and shall be suitably punched or drilled for drainage.

1.3.4 Sizing and Design

Sizing and design of elevated tank shall be in accordance with Section 4 of AWWA D100. The Contractor shall submit a certificate signed by a registered professional engineer providing: (1) description of the entire tank and foundation structural design loading conditions, (2) description of structural design methods and codes used in establishing allowable stresses and safety factors, (3) statement that the structural design has been checked by experienced engineers specializing in hydraulic structures to ensure that design calculations for member sizes, dimensions, and fabrication processes are as prescribed by ACI and AWWA standards, and (4) certification that the

completed work was inspected in accordance with AWWA D100 or AWWA D103 as applicable.

1.3.5 Hydropneumatic Tanks

The system includes a steel horizontally mounted hydropneumatic tank with supports and foundation, integral air compressor, pressure relief valve, access hatch, inlet and outlet piping, level sensors and controls, pressure switches, level switches, solenoid valves, air check valves, control panels, wiring and accessories, and protection against freezing with either an insulation coating or a thermostatically controlled heater system.

1.3.6 Coatings Certification

Coating materials for interior applications and all other materials which will be in normal contact with potable water shall conform to NSF 61. Certification by an independent third-party organization that all interior coatings and materials, that come in contact with potable water, comply with NSF 61 shall be provided.

1.4 DELIVERY, HANDLING AND STORAGE

Deliver paint in unopened containers with unbroken seals and labels showing designated name, specification number, color, directions for use, manufacturer, and date of manufacture, legible and intact at time of use. Handle and store water storage tank systems, components, and parts to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling.

PART 2 PRODUCTS

2.1 MATERIALS - ELEVATED TANK

Materials shall conform to the following requirements:

2.1.1 Steel

Section 2 of AWWA D100 or Section 2 of AWWA D103.

2.1.2 Shop Fabrication

Section 9 of AWWA D100 or Section 7 of AWWA D103.

2.1.3 Ductile-Iron Pipe

Pipe for fluid conductors, except for overflow pipe, shall be ductile-iron pipe and shall be either of the following:

2.1.3.1 Bell-and-Plain End Pipe

AWWA C150/A21.50 and AWWA C151/A21.51, for not less than 1035 kPa working pressure, unless otherwise shown or specified. Joints shall be push-on or mechanical-joint conforming to AWWA C111/A21.11. Pipe shall be cement mortar

lined in accordance with AWWA C104/A21.4. Linings shall be standard thickness.

2.1.3.2 Flanged Pipe

Flanged pipes shall conform to the applicable portions of AWWA C110/A21.10, AWWA C115/A21.15 and AWWA C151/A21.51, for not less than 1035 kPa working pressure, unless otherwise shown or specified. Pipe shall have flanged ends per AWWA C115/A21.15. Pipe shall be cement mortar lined in accordance with AWWA C104/A21.4. Linings shall be standard thickness.

2.1.4 Specials and Fittings (except for overflow pipe)

2.1.4.1 Ductile-Iron with Bell-and-Plain End

AWWA C110/A21.10 and AWWA C151/A21.51 for not less than 1035 kPa working pressure, unless otherwise shown or specified. Specials and fittings shall be cement mortar lined in accordance with AWWA C104/A21.4. Linings shall be standard thickness.

2.1.4.2 Ductile-Iron with Flanged Ends

AWWA C110/A21.10 and AWWA C151/A21.51 for not less than 1035 kPa working pressure unless otherwise shown or specified. Fittings shall have flanged ends per AWWA C110/A21.10. Specials and fittings shall be cement mortar lined in accordance with AWWA C104/A21.4. Linings shall be standard thickness.

2.1.4.3 Fittings for Screw-Joint Pipe

Malleable-iron, galvanized, 1035 kPa, ASTM A 197/A 197M, threaded ends, ASME B16.3.

2.2 ASSEMBLIES - ELEVATED TANKS

2.2.1 Tank Accessories

Section 7 of AWWA D100 or Section 5 of AWWA D103 and as specified. Additional requirements for accessories are as follows:

2.2.1.1 Manholes and Pipe Connections

Section 7 of AWWA D100 and Section 5 of AWWA D103 represent the minimum requirements.

2.2.1.2 Overflow

The overflow for the tank shall consist of an overflow weir and outside drop pipe, adequately supported. The overflow pipe shall be steel, ASTM A 53/A 53M or equal, and shall terminate 300 to 600 mm above grade and shall be fitted with a flapper valve or screen to prevent ingress of animals and insects.

2.2.1.3 Vent

Vent shall be welded to the cover plate of the center manhole on the roof. Vent will be tank manufacturer's standard type mushroom vent with aluminum

bird screen. The free area of the vent shall be determined by the Contractor. Screening for vent shall conform to Section 5.7.2 of AWWA D100 or Section 5.7.2 of AWWA D103which ensures fail-safe operation in the event that screen frosts over and the bottom of the screen shall be sufficiently elevated for snow consideration in the area.

2.2.1.4 Ladders and Safety Devices

Ladders and safety devices shall be provided in accordance with Sections 7.4 and 7.5 of AWWA D100 or Sections 5.4 and 5.5 of AWWA D103. Location of ladders shall be as shown on the drawings. Sections 7.4 and 7.5 of AWWA D100 and Secions 5.4 and 5.5 of AWWA D103 represent the minimum requirement. In addition, safety cage, rest platforms, roof ladder handrails, and other safety devices shall be provided as required by federal or local laws or regulations.

2.2.1.5 Scaffold Cable Support

Provision shall be made for the attachment of a scaffold cable support at the top of the roof on welded tanks.

2.2.1.6 Landing for Roof Access

Provide a landing, length as directed, a minimum of 600 mm wide with a standard guard railing. Provide a structural steel railing with a top rail 1050 mm above landing platform with an intermediate rail halfway between. Guard rail shall be capable of withstanding a force of 888 N applied in any direction. Install a steel toe board with minimum height of 100 mm. Bottom of toe board shall be a maximum 6 mm from platform top. Extend guard rail and toe board entire length of landing except where access openings are required. For landing floors use diamond plates a minimum of 6 mm thick, punched or drilled for drainage. Hatches if any, through landing floor shall be counterbalanced or otherwise arranged to open from below.

2.2.1.7 Coating for Welded Tanks

Provide exterior and interior coating systems conforming to applicable sections of AWWA.

2.2.1.8 Coating for Bolted Tanks

As supplied by the manufacturer.

2.3 MATERIALS - HYDROPHNEUMATIC TANKS

2.3.1 Tank

The tank shall be designed for a working pressure of 1040 KPa. The tank shall be of welded steel construction, and shall be designed, fabricated, tested, and stamped according to Section VIII, Division 1, of the ASME Boiler and Pressure Vessel (BPVC) Code.

2.3.2 Tank Supports

The tank shall be provided with structural type base supports capable of supporting the tank filled with water. The tank shall be installed in the horizontal position as shown on the drawings.

2.3.3 Tank Fittings

The tank shall be furnished with a standard size access hole and cover, a drain connection, a pressure gauge connection, and connections for inserting water level probes, if required.

2.3.4 Air Compressor

The tank shall be furnished with a standard size access hole and cover, a drain connection, a pressure gauge connection, and connections for inserting water level probes. Refer to electrical specifications for water level probe information.

2.4 AUTOMATIC PRESSURE AND VOLUME CONTROL - HYDROPHEUMATIC TANKS

2.4.1 General

General: Provide an automatic pressure and volume control system for use on the hydropneumatic tank. Tank normal operation shall provide pressure between low pressure of 410 KPa and high pressure of 520 Kpa (60 psi and 75 psi). Furnish miscellaneous materials required to mount the control and make connections. The unit control panel shall activate the pump and solenoid valves by monitoring the pressure and water level via tank mounted pressure switches and water level sensors.

a. The hydropneumatic tank volumes shall be as shown on the drawings. Other configurations and volumes may be considered but must provide for an average daily drawdown equal to at least 100 percent of the average total daily water demand for the ANCOP Urban, Patrol, and Brigade HQ sites, and average daily drawdown of 75 percent of the average total daily water demand for the BP Zone A and B sites. The intent is to provide residual system pressure of 275 kPa (40 psi)or more for a period of 18 hours for BP ZONE sites, and 24 hours for ANCOP sites with no water added to the system and average daily water demands.

2.4.2 Mode of Operation

The automatic pressure and volume control system shall perform the following functions:

a. At the predetermined low pressure level in the hydropneumatic tank, close an induction relay circuit to start the well pump and inflow of water.

b. After the water injection has started and the water level has increased, control shall be transferred to a high-level electrode which shall open the contacts on one or both induction relays and stop the inflow of water a pre-determined high water level in the hydropneumatic tank.

c. If pressure in the hydropneumatic tank is below the higher operating pressure when the high-water level is reached, a pressure switch shall start the air compressor and open a solenoid value in the compressed air-supply line and then close this solenoid value when the desired air pressure has been obtained at the pre-determined high-water elevation in the hydropneumatic tank.

d. To prevent air locking of the hydropneumatic tank, the compressed air-supply solenoid value shall be inoperative unless the water level in the hydropneumatic is at the high-water elevation, or is within an adjustable time delay of 0 to 3 minutes of high level.

2.5 CONCRETE WORK

Concrete work shall conform to Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

2.6 CHLORINE

AWWA B300 for hypochlorites or AWWA B301 for liquid chlorine, mixed with water to give the solutions required in AWWA C652.

PART 3 EXECUTION

3.1 PREPARATION - HYDROPNEUMATIC TANKS

3.1.1 Pipe Connections

Shall be covered for protection and to prevent entrance of foreign mattar during shipment and while awaiting installation.

3.1.2 Verification of Openings

Prior to shipment verify location and sizes of all openings in hydropneumatic tank.

3.2 FOUNDATIONS

Construct foundations for the elevated tank columns and riser of concrete, reinforced where necessary, and design same in accordance with Section 12 of AWWA D100 or Sections 11 and 8.5 of AWWA D103 for earth with a bearing value to be determined by the Contractor and constructed in conformance with the applicable requirements of Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE, except as shown or specified herein. Factor of safety on overturning of elevated tanks under design wind load shall be 1.33 minimum. When a footing is required, an inverted truncated pyramid of earth with 2 on 1 side slopes above top of footing may be used in determining overturning stability.

Construct foundations for hydropneumatic tank of concrete, reinforced where necessary, and design same in accordance with the applicable requirements of Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE, except as shown or specified herein.

3.3 EXCAVATING, FILLING, AND GRADING

Excavating, filling, and grading shall conform to the applicable requirements of Section 31 00 00 EARTHWORK.

3.4 TANK INSTALLATION

Tank installation shall be in accordance with the following requirements as applicable:

3.4.1 Welding

Section 8 of AWWA D100 or Section 6 of AWWA D103.

3.4.2 Erection/Placement

Erect elevated tanks as per Section 10 of AWWA D100 or Section 8 of AWWA D103.

Clean, shim, anchor, and grout hydropneumatic tank in place in the location shown on the drawings. Following installation, connect the hydropneumatic tank to the piping system and install instruments and safety devices as shown on the drawings.

Install hydropneumatic tank automatic pressure and volume controls in accordance with the manufacturer's instructions as required to meet the project requirements. Installation shall include making necessary conduit, wiring, air-supply piping, and grounding connections.

3.4.3 Inspections and Testing

Tank inspection and testing shall be in accordance with Section 11 of AWWA D100 or Section 9 of AWWA D103. Mill and shop inspections are required and shall be performed by an approved commercial inspection agency. The Contractor shall perform the radiographic inspections of the welded tank shell, the hydrostatic test and the vacuum box leak test of the tank bottom. Final hydrostatic and leak tests shall be performed before painting of welded tanks.

3.5 PIPING INSTALLATION (EXCEPT FOR OVERFLOW PIPING)

3.5.1 General Guidelines

Where details of fabrication or installation are not shown on the drawings, installation shall conform to Section 1 and 3 of AWWA C600.

3.5.2 Testing of Valves and Piping

After the elevated tank has been erected and the valves and piping installed, and before field painting is begun, the valves and piping shall be hydrostatically tested in accordance with Section 4 of AWWA C600. The Contractor shall replace with sound material any defective material disclosed by the pressure test, and the test shall be repeated until the test results are satisfactory.

3.5.3 Polyethylene Encasement of Underground Ductile-Iron Piping

Polyethylene encasement of underground ductile-iron piping shall be provided in addition to asphaltic coating in accordance with AWWA C105/A21.5.

3.6 PAINTING AND COATING OF TANK

Each coating manufacturer's technical data, application instructions, Material Safety Data Sheets (MSDS), and certificate for compliance for VOC content shall be submitted to the Contracting Officer. Application, curing time, mixing and thinning of the coating materials shall be in strict accordance with the manufacturers instructions. The use of thinners shall

not alter the required minimum dry thickness or adversely affect the VOC content.

3.6.1 Exterior Surfaces (Welded Tanks)

Surface preparation for steel shall be near-white SSPC-6. A two-component catalyzed epoxy prime and intermediate coat, each a minimum of 0.076 mm thick, followed by a two-component catalyzed aliphatic polyurethane finish coat, a minimum of 0.038 mm thick, conforming to Type V of SSPC PS Guide 17.00 shall be applied. The prime coat shall be a green primer, Formula 150 in accordance with MIL-P-24441. The intermediate coat shall be white Formula 152 in accordance with MIL-P-24441 and may be tinted with pigment color. The finish coat shall be white.

3.6.2 Interior Surfaces (Welded Tanks)

A prime coat at least 0.076 mm thick and a white final coat at least 0.127 mm thick shall be applied. Each coat shall be a two-component catalyzed epoxy in accordance with MIL-PRF-23236. The primer shall contrast with the color of the finish coat. Four coats, each at least 0.038 mm thick, of VR-3 vinyl resin paint in accordance with BOR Paint Mnl shall be applied. The second, third, and fourth coats shall be of contrasting colors.

3.6.3 Bolted Tanks

The tanks shall have a coating applied to both the interior and exterior surfaces in accordance with Section 10 of AWWA D103. Color shall be as approved.

3.7 INSULATION

Provide a sprayed on polyurethane foam factory insulation coating suitable for outdoor aplications, or a thermostatically controlled freeze protection system.

3.8 DISINFECTION

The tank and connecting lines thereto shall be disinfected with chlorine before being placed in operation.

3.8.1 Tank

The tank shall be disinfected by the Contractor in accordance with AWWA C652. After the chlorination procedure is completed and before the storage facility is placed in service, the Contracting Officer will collect samples of water in properly sterilized containers for bacteriological testing from the full facility in accordance with Section 7 of AWWA C652. The tank will not be accepted until satisfactory bacteriological results have been obtained.

3.8.2 Piping

The valves and piping shall be disinfected by the Contractor in accordance with Section 33 11 00 WATER DISTRIBUTION.

3.9 INSPECTION AND REPAIR

Prior to tank repair job, perform a detailed inspection of the structure and submit report by a certified inspector.

-- End of Section --

SECTION 33 20 00

WATER WELLS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA A100	(2006) Water Wells
AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C200	(1997) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C206	(2003) Field Welding of Steel Water Pipe
AWWA C654	(2003) Disinfection of Wells

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 312/A 312M	(2006) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM D 1586	(1999) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587	(2000) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2239	(2003) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(2006) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4750	(1987; R 2001) Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)
ASTM D 5079	(2002) Preserving and Transporting Rock Core Samples
ASTM D 5088	(2002) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5299	(1999) Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities
ASTM D 5521	(1994; E 1998) Development of Ground-Water Monitoring Wells in Granular Aquifers
ASTM D 5608	(2001)Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites
ASTM F 480	(2002) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80

U.S. ARMY CORPS OF ENGINEERS (USACE)

CED TR GL-85-3	(1985) Geotechnical Descriptions of Rock and Rock Masses

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

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

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.2 MEASUREMENT AND PAYMENT

Payment for each specified item will be made at the contract unit price for that item. Payment will include full compensation for equipment, materials and labor for drilling; removal and disposal of temporary casing, cuttings, and drill fluid; preparation of borehole logs; and sample handling, containers, storage, and testing. Depth, logging, installation, casing, riser pipe, and well screen shall be measured by linear distance. Payment will not be allowed for test holes or wells abandoned due to construction practices not in accordance with this specification, faulty construction practices or for the convenience of the Contractor.

1.2.1 Test Hole

Compensation for the test hole will be made at the contract unit price and will include material, equipment, and labor required to drill and perform tests on the test hole. Depth shall be measured as the total linear distance between ground surface and bottom of hole. If the test hole is developed into the permanent well with no increase in diameter, the Contractor will be compensated as described below, and separate payment will not be made for the test hole.

1.2.2 Water Well

Compensation for the water well will be made at the contract unit price and will include material, equipment, and labor required to drill, develop, perform tests, and complete the permanent well. Depth shall be measured as the total linear distance between ground surface and bottom of hole.

1.2.3 Observation Well

Compensation for an observation well will be made at the contract unit price and will include material, equipment and labor required to drill, install, and complete the observation well, as well as perform tests and permanently grout it after use. Depth shall be measured as the total linear distance between ground surface and bottom of hole.

1.2.4 Geophysical Logging

The "Geophysical Logging" unit price will include interpretation of the logs and their delivery to the Government.

1.2.5 Well or Test Hole Decommissioning/Abandonment

Permanent decommissioning/abandonment of wells or test holes will be paid for only if it becomes necessary to abandon a well or test hole as specified, and only for work completed and accepted as specified. Payment will include compensation for drilling, casing removal, well sampling, materials, cement, mixing of cement, bentonite, and water, pumping of grout, equipment, removal of foreign objects, and transportation necessary to abandon the well or test hole and for the required well or test hole abandonment records.

1.2.6 Site Cleanup

Separate payment will not be made for cleanup of the site. Cleanup will mean restoring the site to its pre-construction condition, in accordance with paragraph SITE CLEANUP. Cleanup will be considered part of and incidental to the drilling, construction, and/or decommissioning of the well.

1.3 GENERAL REQUIREMENTS

The well shall be located where directed, and be constructed in accordance with these specifications. Each well shall be installed to prevent aquifer contamination by the drilling operation and equipment, intra- and inter-aquifer contamination, and vertical seepage of surface water adjacent to the well into the subsurface, especially the well intake zone.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Installation Diagrams; G

As-built installation diagram and supporting calculations for each well installed, prepared by the geologist present during well installation operations, within 30 working days of the completion of the well installation procedure.

Pump installation diagrams and calculations shall be submitted by a Professional Engineer.

SD-03 Product Data

Well Installation Plan; G

A plan as specified in paragraph WELL INSTALLATION PLAN describing the drilling methods, sampling, and well construction and well development 30 calendar days prior to beginning drilling operations. Mobilization activities may start prior to submittal of the plan. The plan shall be approved and signed by an experienced geologist as specified in paragraph QUALIFICATIONS.

Well Material

Catalog data, and name of supplier, for well screens (to include the screen slot size), casing, riser pipe, filter pack material, bentonite, cement, centralizers, surface protective covers, well vaults, locking caps, airline oil filters for pneumatic drilling, dedicated sampling equipment, pumps, and chemical specifications on drill lubricants, tracers, disinfecting agents, and drill fluid additives, if used. Catalog data shall include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

Qualifications

Personnel qualification documentation.

Site Conditions

A copy of all permits, licenses, or other legal requirements necessary for execution of the work shall be furnished 10 working days before commencement of the work.

Geophysical Logging

The Contractor shall prepare a graphic boring log to scale showing the required details. Five prints of the boring log drawing shall be submitted within 10 working days after completion of the test hole. This drawing shall be used for determining the well design, design of the filter pack, well screen location and screen openings.

SD-06 Test Reports

Survey Maps and Notes

Survey maps and notes, including a tabulated list of all wells and monuments, copies of all field books, maps showing the locations, and elevations of all wells, datum used (e.g. state plane NAD27, NAD83, UTM, etc.), elevation datum, units of measurement, and all computation sheets shall be submitted within 10 working days after completion of the survey. Also, a diagram showing where on the top of the well the elevation was determined by the surveyor.

Well Development Records

A well development record, for each well, within 10 working days of the completion of development.

Geophysical Logs

Interpreted geophysical logs shall be submitted within 10 working days of the completion of said logging.

Decommissioning/Abandonment Records

A well decommissioning record, for each well, or test hole abandoned, within 10 working days of the completion of the abandonment procedure.

Project Photographs

Before, during, and after completion of the work, the Contractor shall take photographs of each well installation site. Photographs shall also be taken of any rock that is cored at the site.

Water Source

Decontamination and drilling water source analytical test results shall be submitted within 10 working days before beginning drilling operations.

Filter Pack

Filter pack material test results; sieve and chemical analyses, shall be submitted within 10 working days after completion of the test hole.

Tests.

Test Reports within 24 hours following the conclusion of each test.

SD-07 Certificates

Casing

Cement and Bentonite Grout

Air line and gauge

Drilling mud

Well Screens

Water removed

Graveling equipment list

Construction of Filter Pack

1.5 WELL INSTALLATION PLAN

The following requirements shall be incorporated into the Contractor's Well Installation Plan and followed in the field. The plan shall include, but shall not be limited to, a discussion of the following:

a. Description of well drilling methods, and installation procedures, including any temporary casing used, placement of filter pack and seal materials, drill cuttings and fluids disposal, and soil/rock sample disposition.

b. Description of well construction materials, including well screen, riser pipe, centralizers, air line and gauge, tailpiece (if used), filter pack and filter pack gradation, bentonite or drilling mud, drilling fluid additives (if used), drilling water, cement, and well protective measures.

c. Description of quality control procedures to be used for placement of filter pack and seals in the boring, including depth measurements.

d. Forms to be used for written boring logs, installation diagrams of wells, geophysical logs, well development records, well sampling data records, state well registration forms, and well abandonment records.

e. Description of contamination prevention and well materials and equipment decontamination procedures.

f. Description of protective cover surface completion procedures, including any special design criteria/features relating to frost heave prevention. The maximum frost penetration for the site shall be included in this description.

g. Description of well development methods to be used.

h. List of applicable publications, including state and local regulations and standards.

i. List of personnel assignments for this project, and personnel qualifications.

j. Description of well decommissioning/abandonment procedures.

k. Description of well capacity testing techniques.

l. Description and discussion of geophysical techniques to be employed at the site.

m. Description of permanent pump to be installed, and discussion of pump operating tests to be employed at the site.

n. Description of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

1.6 QUALIFICATIONS

A geologist with at least 3 years experience in soil and rock logging, and well installation, shall be on site and responsible for all geophysical and borehole logging, drilling, well installation, developing and testing activities. Geophysical log interpretation shall be done by a qualified log analyst. The log analyst shall be able to demonstrate competence through background, training, and experience when so called upon. The Contractor shall have a minimum of 10 years of well installation experience.

1.7 TEST HOLES AND OBSERVATION WELLS

1.7.1 Test Holes

Before starting construction of the well, a test hole of at least 100 mm in diameter shall be drilled at the location of the well into the target water bearing stratum as directed by the Contracting Officer. Test holes should be drilled in a manner to protect the subsurface from surface contamination. Test holes should be carefully advanced and sampled to determine the presence of the upper aquiclude if one exists. The boring should then be properly cased, grouted, and sealed into the aquiclude before the boring is advanced through the aquiclude into the aquifer. The test hole shall be used to determine the expected yield from the well, water quality, optimum depth, and to log the strata encountered. Before conducting a capacity test, the well shall be cased, and screened in accordance with these specifications. Test holes shall be logged in accordance with paragraph BOREHOLE LOGS. A temporary casing may be used. If used, the temporary casing shall be seated into the top of the rock or at the top of the stratum being tested whichever is

deeper. The test hole may be converted to the permanent well, in accordance with these specifications. If the test hole is not used for the permanent well, the test hole shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

1.7.2 Sampling for Geotechnical Analysis

Samples shall be taken of all materials penetrated by each drilled well/test hole. Soil sampling shall be done with a split or thin-walled tube sampler using standard sampling techniques in accordance with ASTM D 1586 or ASTM D 1587. Samples shall be extracted from their in-situ environment in as near an intact, minimally disturbed condition as technically practical. Samples shall be obtained continuously through the area expected to be screened. The Contractor shall provide sieve analyses of all drive-sampled material. Sieve analyses shall be conducted in accordance with ASTM C 136. The gradation of the natural formation shall be determined by the Contractor through the use of sieve analyses performed on formation samples taken from the areas to be screened. Drive-sampled materials shall be placed in airtight containers and labeled as specified in paragraph SAMPLE CONTAINERS. Samples shall be delivered to the Contracting Officer designated facility. Representative soil samples s hall be tested for grain-size distribution by mechanical means (sieves down to the 0.074 mm size according to ASTM C 136), moisture content according to ASTM D 2216 and Atterberg limits according to ASTM D 4318. Description and identification of soils shall be done in accordance with ASTM D 2488. Laboratory classification of soils shall be done in accordance with ASTM D 2487. Sampling shall be performed to allow completion of the documents described in paragraph BOREHOLE LOGS.

1.7.3 Observation Wells

After completion of the test hole, 1 observation well, or more as directed, at least 45 mm in diameter shall be drilled to the target water bearing stratum, at an appropriate location near the test hole. The observation well shall be used in conjunction with the yield test of the test hole or capacity test of the well. After final acceptance of the pump well by the Contracting Officer, the observation well shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

1.8 GEOPHYSICAL LOGGING

The total depth of each test hole drilled shall be geophysically logged. Geophysical logging shall be documented in accordance with paragraph Geophysical Logs. Log analyses and interpretations shall be made by a person qualified in accordance with paragraph QUALIFICATIONS.

1.9 ABANDONMENT OF WELLS

If the Contractor fails to construct a well of the required capacity, or if the well is abandoned because of loss of tools, or for any other cause, the Contractor shall abandon the hole as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

1.10 NOTIFICATION

The Contracting Officer shall be notified 10 days prior to drilling.

1.11 DELIVERY, STORAGE, AND HANDLING

Well materials shall be stored and maintained in a clean, uncontaminated condition throughout the course of the project. Filter pack material shall not be allowed to freeze before installation.

1.12 SITE CONDITIONS

Access to each well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work, is the responsibility of the Contractor . Obtaining rights-of-entry is the responsibility of the Government. The Contractor shall visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site. If clearing, or relocation is necessary, the Contractor, and the Contracting Officer shall agree on a suitable clearing, or relocation plan, and the location of any required access road.

PART 2 PRODUCTS

2.1 CASING

All casing, screen, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well.

2.1.1 Steel Casing and Couplings

Steel casing shall be new carbon steel, conforming to ASTM A 139/A 139M Grade B, or standard weight galvanized, black steel pipe, conforming to ASTM A 53/A 53M, or steel pipe conforming to AWWA C200. Joints shall be either threaded and coupled, or field welded in accordance with AWWA C206.

2.1.2 Plastic Casing and Couplings

Plastic casing pipe and couplings shall be schedule 80, threaded flush joint (or other joint type as approved by the Contracting Officer) and conform to ASTM F 480 and ASTM D 1785.

2.2 WELL SCREENS

Well Screens shall be a minimum of 100 mm nominal diameter, and shall be directly connected to the bottom of the inner casing by an approved method. The length of the screen shall be sufficient to provide an intake area capable of passing not less than the minimum required yield of the well, at an entrance velocity not exceeding 30.5 mm/s. The opening, or slot size of the screen, shall be determined by the Contractor based on analysis of the distribution of the grain size of the aquifer materials encountered during drilling or artificial filter pack if applicable, be compatible with the material surrounding the screen, and shall be submitted for approval as part of the well installation plan. The well screen shall be of sufficient size and design to hold back and support the gravel used in the filter pack envelope and in-situ material surrounding the screen. The screen and all accessories required for satisfactory operation shall be essentially standard products of manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable. "Blanks" in the well screen may be utilized in nonproductive zones, or where centering devices are needed in the screened area, and shall be considered "casing." The bottom

section, below the screen, shall be sealed watertight by means of a flush threaded or welded end cap of the same material as the well screen.

2.2.1 Metal Screen

Metal screen shall be of an approved wire-wound type and shall be type 304 or type 316 stainless steel, conforming to the applicable requirements of AWWA A100. A wire-wound screen manufactured with supporting bars or core of material different from the wire will not be acceptable. Joints shall be made of threaded couplings of the same material as the screens or by brazing or welding in accordance with AWWA C206.

2.2.2 Plastic Screen

2.2.2.1 Plastic Pipe

Plastic pipe shall be thermoplastic manufactured by a molding, extrusion or sonic welding process. The plastic compounds shall be uniform in composition and shall not contain additives or foreign matter. The molding or extrusion process shall produce pipe that is homogeneous throughout and free from visible cracks, holes, foreign inclusions or other defects. Pipe produced by simultaneous multiple extrusion shall have strong uniform bonds between any two layers so that the layers cannot be separated. Plastic pipe shall be uniform in color, opacity, density and other physical properties. Plastic pipe, and screen material shall conform to ASTM F 480. All PVC plastic pipe shall conform to ASTM D 1785.

2.2.2.2 Bonding Materials

Bonding materials, proportions and preparation of adhesives, the method of application, and the procedure used for making and curing the connections shall conform to the recommendations of the plastic pipe manufacturer and ASTM F 480. The pot life, initial setting time and external heating requirements for curing of the adhesive shall be suitable for the procedure and climatic and other conditions and shall be varied as required to suit changes in climatic and other conditions. The system for making joints at the well site shall provide a curing period adequate to develop the ultimate strength of the completed joint. Self-tapping screws or other devices for holding adhesive-coated pipe in the couplings during the setting period shall not be utilized. Newly-made joints in the casing shall not be stressed, lowered into the well or submerged in water prior to complete curing of the adhesive.

2.2.2.3 Plastic Well Screen

Plastic well screen shall be provided with perforations which shall consist of either machine-sawed slots, continuous wrap or wound, or drilled, formed, or molded openings, and which shall have smooth, sharp-edged openings free of burns, chipped edges, or broken pieces on the interior and exterior surfaces of the pipe. The pattern of the openings shall be uniformly spaced around the periphery of the well screen. Compatible slot sizes of screens and filter-pack gradations or surrounding material shall be designed by the Contractor and furnished to the Contracting Officer. The plastic pipe screen strength properties shall be equivalent to those for the plastic casing with which the screen is used.

2.3 FILTER PACK

Filter pack material shall be a product of a commercial sand and gravel supplier, shall be properly sized and graded for the surrounding soil encountered, and shall be composed of clean, round, hard, waterworn siliceous material, free of flat or elongated pieces, organic matter, or other foreign matter. The filter material shall be of a size which will allow the maximum flow of water into the well and prevent the infiltration of sand and silt. The gradation of the filter material shall be such that the uniformity coefficient is not more than 2.5..

2.4 BENTONITE SEAL

The bentonite seal, intended to keep grout from entering the filter pack, shall consist of hydrated granular, or pelletized, sodium montmorillonite furnished in sacks or buckets from a commercial source and shall be free of impurities which adversely impact the water quality. If the bentonite seal is located above any borehole fluid levels, a layer of fine sand shall be placed at the top of the bentonite seal, to provide an additional barrier to any downward migration of grout.

2.5 CEMENT AND BENTONITE GROUT

2.5.1 Cement Grout

Cement grout shall consist of Portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 2 parts, by weight, of sand to 1 part of cement with not more than 23 liters of water per 42.6 kg of Portland cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

2.5.2 Bentonite Grout

High-solids bentonite grout shall be made from sodium bentonite powder and/or granules. Water from an approved source shall be mixed with these powders or granules to form a thick bentonite slurry. The slurry shall consist of a mixture of bentonite and the manufacturer's recommended volume of water to achieve an optimal seal. The slurry shall contain at least 20 percent solids by weight and have a density of 4.3 kg/L of water or greater.

2.6 PERMANENT PUMP

Permanent pump shall be an approved submersible type with a capacity sufficient to deliver the pumping rates as described in Section 43 21 39 "PUMPS, SUBMERSIBLE, VERTICAL TURBINE, AND HAND OPERATED".

2.7 SAMPLE CONTAINERS

Drill cuttings and driven samples for geotechnical purposes shall be placed in air-tight liter size plastic containers and labeled with the project name, date of sample, well number and depth at which the sample was taken. Both the container and lid shall be labeled in permanent indelible ink. Jars shall be placed in partitioned cardboard boxes. Boxes shall be labeled with project number and well number. Containers and boxes shall be furnished by the Contractor. Core samples shall be preserved and prepared for transport as described in ASTM D 5079. Cored rock samples shall be placed in wooden core

boxes as indicated on the drawings. Spacers shall be placed in the proper positions in the core boxes to show the location and actual extent of voids and core losses as clearly as possible. The spacers shall be made of wood or some other relatively light material which is of sufficient strength to withstand jarring and crushing in handling. Spacers shall be of a strongly contrasting color pattern so that core losses will be accented either by direct observation or in photographs. In the smaller sizes, up to and including 150 mm, the spacers shall be the same width as the cores. The outside and the inside of the core box lid shall be labeled with the project name, hole number, date sampled, location, surface elevation, core box number, and interval of depth of core. The information on the label shall be such that it can clearly be read in photographs of the core box. Both ends of the core box shall also be labeled with the hole number and box number. The core shall be placed in the core box starting at the left hand corner on the hinge side and running to the right. Successive cores down the hole shall be placed in successive troughs, starting from the back and working toward the front of the box so that the core can be read in the same manner as a printed page, from left to right, when standing in front of the open box.

PART 3 EXECUTION

3.1 PROTECTION OF EXISTING CONDITIONS

The Contractor shall maintain existing survey monuments and wells, and protect them from damage from equipment and vehicular traffic. Any items damaged by the Contractor shall be repaired by the Contractor. Wells requiring replacement due to Contractor negligence shall be re-installed according to these specifications. Wells scheduled for abandonment shall be protected from damage so that abandonment may be performed according to these specifications. Prior to excavation, the Contractor shall obtain written approval from the local utility companies to drill at each site, to avoid disturbing buried utilities.

3.2 PREPARATION

3.2.1 Decontamination

Contractor shall be responsible to insure all drilling equipment is free of potential contaminants prior to drilling at any site.

3.3 WELL CONSTRUCTION

The drilling method shall be as approved by the Contracting Officer and shall conform to all state and local standards for water well construction. The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller. The drilling method shall prevent the collapse of formation material against the well screen and casing during installation of the well. The inside diameter of any temporary casing used shall be sufficient to allow accurate placement of the screen, riser, centralizer(s), filter pack, seal and grout. Casing pipe, well screens, and joint couplings shall be of compatible materials throughout each well. The well shall be a filter pack well or naturally developed well activated in the water-bearing stratum or stratum based on test hole data. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be initially drilled from the ground surface to the uppermost level of the water bearing strata or top of rock and the bottom of the outer casing set at this elevation. The hole below the outer casing shall

penetrate the water bearing stratum a sufficient depth to produce the required amount of water without causing excessive velocities through the aquifer. During construction of the wells, precautions shall be used to prevent tampering with the well or entrance of foreign material. Runoff shall be prevented from entering the well during construction. If there is an interruption in work, such as overnight shutdown or inclement weather, the well opening shall be closed with a watertight uncontaminated cover. The cover shall be secured in place or weighted down so that it cannot be removed except with the aid of the drilling equipment or through the use of drill tools.

3.3.1 Setting Outer Casing

The outer casing shall not be less than 200 mm in diameter. The hole shall be of sufficient size to leave a concentric annular space of not less than 65 mm and not more than 150 mm between the outside of the outer casing and the walls of the hole. The annular space between the outer casing and the walls of the holes shall be filled with cement grout. Acceptable methods of grouting are detailed in AWWA A100; the approved method shall specify the forcing of grout from the bottom of the space to be grouted towards the surface. A suitable grout retainer, packer, or plug shall be provided at the bottom of the inner casing so that grout will not leak into the bottom of the well. Grouting shall be done continuously to ensure that the entire annular space is filled in one operation. After grouting is completed, drilling operations shall not be resumed for at least 72 hours to allow proper setting of the grout.

3.3.2 Temporary Casing

Temporary well casing of either iron or steel of sufficient length to case to the bottom of all borings shall be available at the construction site. The Contracting Officer will direct the use of a temporary casing to the bottom of the boring during drilling and placement of screen, riser, and filter pack when he believes it is necessary to provide adequate support to the sides of the hole. When the walls of the boring will require support only during development operations a temporary casing will be required to extend only to a depth 1 m below the top of the filter pack. The temporary casing, shall have sufficient thickness to retain its shape and maintain a true section throughout its depth, and may be in sections of any convenient length. The temporary casing shall be such as to permit its removal without disturbing the filter pack, riser, or well screen. The setting of temporary casing shall be such that no cavity will be created outside of it at any point along its length. In the event the temporary casing should become unduly distorted or bent it should be discarded and a new casing should be used during installation of any additional well.

3.3.3 Construction of Inner Casing and Screen

After the grout has set, the hole below the outer casing shall be reamed at the required diameter, to the required depth, by an approved method which will prevent caving of the hole before or during installation of the filter pack, well screen and inner casing. In lieu of reaming, the entire well may be drilled to the diameter of the filter pack with an annular space between the inner casing and outer casing equal to the thickness of the filter pack. The outer casing shall be increased in size to provide for this space, if this option is elected. The well screen and inner casing shall be firmly attached, and lowered into the hole by a method which will allow for control

of the rate of fall of the well screen and inner casing at all times. Well screen and inner casing shall not be dropped or allowed to fall uncontrolled into the hole. The inner casing shall extend up through the outer casing to 0.3 meters above the proposed well house floor elevation. Approved centering devices shall be installed at a spacing of 120 degrees, between the outer casing and inner casing prior to well construction at intervals not exceeding 8 m along the length. If the screen length is greater than 8 meters, a 1 meter length of blank casing shall be placed in the middle of the screen interval for placement of centering devices. Centering devices shall not be placed on the screened interval, or within the bentonite seal, if used.

3.3.4 Construction of Filter Pack (if natural formation not suitable)

After the screen and inner casing have been concentrically set in the hole below the outer casing, the approved filter pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole in the water bearing stratum with filter pack material. A tremie pipe having an inside nominal diameter of not less than 40 mm shall be lowered to the bottom of the well between the hole and screen. The tremie pipe shall be arranged and connected, at the surface of the ground, to water pumping and graveling equipment so that water and filter material, fed at uniform rates, are discharged as the filter material fills the hole from the bottom up. The tremie pipe shall be raised at a rate that will keep the bottom of the pipe no more than 1 m above the filter material level at all times. If the Contractor desires to use methods of placing filter material other than those specified, the details of the method and equipment proposed shall be submitted to the Contracting Officer, before filter pack placement is begun; however, dumping filter pack material from the surface of the ground and agitating the well in an effort to settle the filter will not be allowed. The filter pack shall be installed continuously and without interruption until the filter pack has been placed to within 10 m above the top of the screen. The depth to the top of the filter pack shall be directly measured, and recorded. Any water added to the filter pack material shall be obtained in accordance with paragraph Water Source. Filter pack material shall be protected from contamination prior to placement by either storing it in plastic lined bags, or in a location protected from the weather and contamination on plastic sheeting. Filter pack material shall not be allowed to freeze before installation. Filter pack material shall be transported to the well site in a manner which prevents contamination by other soils, oils, grease, and other chemicals. Temporary drill casing, if installed, or hollow stem auger, shall be removed simultaneously with the above operation. Filter pack material shall be placed in no greater than 1 m lifts prior to retraction of the temporary casing/auger. A minimum of 150 mm of filter pack shall remain in the temporary casing/auger at all times during filter pack installation. Frequent measurements shall be made inside the annulus during retraction to ensure that the filter pack is properly placed.

3.3.5 Bentonite Seal

After the inner casing and well screen and filter pack have been installed, and after predevelopment of the well, the annular space between the inner and outer casings shall be sealed by use of a bentonite seal. A minimum 1 m thick hydrated bentonite seal shall be placed on top of the filter pack in a manner which prevents bridging of the bentonite in the annulus. The bottom of the bentonite seal shall be a minimum of 2 m above the top of the well screen. The depth to the top of the bentonite seal shall be directly measured, and recorded immediately after placement, without allowance for swelling. If the

bentonite seal is located above any borehole fluid levels, a 300 mm layer of fine sand shall be placed at the top of the bentonite seal.

3.3.6 Grout Placement

After the inner casing and well screen filter pack have been installed, a non-shrinking cement or high-solids bentonite grout, shall be mechanically mixed in accordance with paragraph CEMENT AND BENTONITE GROUT, and placed by tremie pipe, in one continuous operation into the annulus between the inner and outer casings above the bentonite seal to within 80 mm of the ground surface. Grout injection shall be in accordance with AWWA A100. If the casing interval to be grouted is less than 4.5 m, and without fluids after any drill casing is removed, the grout may be placed either by pouring or pumping. The tremie pipe shall be thoroughly cleaned with high pressure hot water/steam before use in each well. The bottom of the tremie pipe shall be constructed to direct the discharge to the sides rather than downward. The discharge end of the tremie pipe shall be submerged at all times. Additional grout shall be added from the surface to maintain the level of the grout as settlement occurs. Work shall not be conducted in the well within 24 hours after cement grouting. The alignment of the well shall be verified by passing a 1.5 m long section of rigid pipe 6 mm smaller in diameter than the inside diameter of the casing through the entire well. If the pipe does not pass freely, the well will not be accepted. The pipe section shall be thoroughly cleaned with high pressure hot water/steam prior to each test.

3.4 WELL DEVELOPMENT

Within 7 days of completion of each well, but no sooner than 48 hours after cement grouting is completed, the well shall be developed. Predevelopment, or development after the filter pack has been installed, but before the annular seal is installed, may be initiated before this minimum 48 hour period. The well shall be developed in accordance with the Well Installation Plan, by approved methods until the water pumped from the well is substantially free from sand, and until the turbidity is less than 5 on the Jackson Turbidity Scale specified in AWWA 10084. Developing equipment shall be of an approved type and of sufficient capacity to remove all cutting fluids, sand, rock cuttings, and any other foreign material. The well shall be thoroughly cleaned from top to bottom before beginning the well tests. Development shall be performed using only mechanical surging, over pumping, or jetting, or a combination thereof per ASTM D 5521. Details of the proposed development method shall be included in the Well Installation Plan. At the time of development of any well, the well shall be free of drawdown or surcharge effects due to pump testing, developing or drilling at another location. The Contractor shall be responsible for maintaining at the well site the needed access and work area and clearance, necessary to accomplish development. The Contractor shall furnish, install, or construct the necessary discharge line and troughs to conduct and dispose of the discharge a sufficient distance from the work areas to prevent damage. Development shall be conducted to achieve a stable well of maximum efficiency and shall be continued until a satisfactory sand test, as specified in paragraph Sand Test, is obtained. During predevelopment of the well, filter pack material shall be added to the annular space around the screen to maintain the top elevation of the filter pack to the specified elevation. The Contractor shall provide an open tube or other approved means for accurately determining the water level in the well under all conditions. If, at any time during the development process it becomes apparent in the opinion of the Contracting Officer that the well may be damaged, development operations shall be

immediately terminated. The Contracting Officer may require a change in method if the method selected does not accomplish the desired results. The Contracting Officer may order that wells which continue to produce excessive amounts of fines after development for 6 hours be abandoned, plugged, and backfilled, and may require the Contractor to construct new wells nearby. All materials pulled into the well by the development process shall be removed prior to performing the pumping test.

3.4.1 Jetting

Jetting should be performed using either a single or double ring jet. If a double ring jet is used the rings should be 600 mm apart. The jetting tool shall be constructed of high-strength material and conservatively designed and proportioned so that it will withstand high pressures. The jetting tool shall have two 7, 8, or 10 mm diameter hydraulically balanced nozzles spaced 180 degrees or four 7, 8, or 10 mm diameter holes spaced 90 degrees apart and which shall exert the jetting force horizontally through the screen slots. The rings shall be constructed such that the tips of the jets shall be within 13 mm from the inner surface of the well screen. The pump used in conjunction with the jetting tool shall be capable of providing a minimum jetting fluid exit velocity of 45 m/s. Prior to commencing jetting, and following each jetting cycle, all sand and/or other materials shall be removed from inside the screen. The jetting process shall start at the bottom of the screen and consist of rotating the jetting tool slowly while rotating the pipe 180 degrees for two minutes at each location then raising the pipe 150 mm. All wells, more than 100 mm in diameter, shall be pumped during the jetting cycle to remove incoming sand and other material. Such pumping shall be at a rate not less than 115 percent of the rate at which fluid is introduced through the jetting tool. This will allow a flow of material into the well as it is being developed. Water used for development shall be free of sand. The contracting officer may require other means of developing the well such as intermittent pumping method, variation of the intermittent pumping method, or surge block if it appears that the development of the well is not producing the desired results.

3.4.2 Intermittent Pumping

Intermittent pumping shall be performed by pumping the well at a capacity sufficient to produce a rapid drawdown stopping the pump (backflow through pump will not be permitted) to permit the water surface to rise to its former elevation, and repeating this procedure. Cycle time for this procedure will vary as directed but will not be more than 3 cycles per minute. A deep well turbine pump, or electric submersible pump with check valve, shall be used with any attachment necessary to accomplish rapid starting and stopping for intermittent pumping. The intake shall be set at least 3 m below the maximum expected drawdown in the well. Prior to commencing intermittent pumping, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. The amount of drawdown may be decreased if, in the opinion of the Contracting Officer, the efficiency of the well might otherwise be impaired.

3.4.3 Surging

Surging of the well shall require use of a circular block, or multiple blocks, which are approximately 25 mm smaller in diameter than the inside diameter of the well and is constructed of a material which will not damage the screen if the block comes in contact with the screen, and a bailer or

pump to remove materials drawn into the well. The surging shall be continued for a period of approximately one hour, or until little or no additional material from the foundation or filter pack can be pulled through the screen. The surge block shall be moved by a steady motion up and down the full length of the well screen. Prior to commencing surging, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. All materials pulled into the well by the surging process shall be removed by the Contractor.

3.4.4 Well Development Criteria

A well development record shall be maintained in accordance with paragraph Well Development Records. Development is complete when all of the following criteria are met:

a. Well water is clear to the unaided eye ,and turbidity less than or equal to 5 Nephelometric Turbidity Units (NTUs),

b. Sediment thickness in the well is less than 1 percent of the screen length

c. A minimum of three times the standing water volume in the well is removed plus three times the volume of all added water and drilling fluid lost during drilling and installation of the well is removed, and

3.5 TESTS

After the wells have been developed, the Contractor shall notify the Government and shall make the necessary arrangements for conducting the capacity tests. If the capacity test indicates that the required capacity can be obtained, the tests for quality of water shall be made. If the capacity and quality tests indicate that the required capacity and quality can be obtained, the permanent well, as specified, shall be completed at that depth. Prior to making quality tests, drilling equipment, tools and pumps contacting well water shall be cleaned with live steam.

3.5.1 Capacity Test

The Contractor shall furnish and install an approved temporary test pump, with discharge piping of sufficient size and length to conduct the water being pumped to point of discharge, and equipment necessary for measuring the rate of flow and water level in the well. An 8 hour step-drawdown capacity test shall be run with the pumping rate and drawdown at the pump well and observation wells recorded every 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; then every 20 minutes for 2 hours. From this point on, readings taken at hourly intervals, until the water level stabilizes, shall be sufficient. Observation wells (piezometers) shall be read on the same schedule as the pump well. During the step-drawdown test, the pumping rate shall be increased in steps at regular intervals. Specific capacity shall be measured for each step. The test shall begin at the rate of the expected capacity of well and at least that rate maintained throughout the duration of the test. The well shall be "step" tested at rates of approximately 1/2, 3/4, 1 and 1 1/2 times the estimated design capacity of the well. If this capacity cannot be maintained for the test period, the capacity test shall be terminated and the test hole drilled deeper or relocated as directed. When the pump is shut off, water level

readings shall be taken during the rebound period for the same intervals of time as the drawdown test. The record of the test, in triplicate, shall be delivered to the Contracting Officer.

3.5.2 Test for Plumbness and Alignment

Upon completion of the permanent well, plumbness and alignment shall be tested by lowering into the well, to the total depth of the well, a plumb 12 m long or a dummy of the same length. The outer diameter of the plumb shall not be more than 13 mm smaller than the diameter of that part of the hole being tested. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being 300 mm wide. The rings shall be cylindrical and shall be spaced one at each end of the dummy and one in the center. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings. The dummy shall be decontaminated as specified in paragraph Decontamination, before use. If the plumb or dummy fail to move freely throughout the length of the casing or well screen for the depth of well or should the well vary from the vertical in excess of two-thirds the inside diameter of that part of the well being tested for each 30 m of depth, the plumbness and alignment of the well shall be corrected by the Contractor. If the faulty alignment and plumbness is not correctable, as determined by the Contracting Officer, the well shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT and a new well drilled at no additional cost to the Government.

3.5.3 Test for Quality of Water

When the capacity test in the test hole has been completed, and again after the yield in the permanent well and drawdown test or capacity test have been completed, the Contractor shall secure samples of the water in suitable containers, and of sufficient quantity, to have bacterial, physical, and chemical analyses made by a recognized testing laboratory. Water Quality Analysis shall address each item specified in the Water Quality Analysis Table at the end of this section. Expenses incident to these analyses shall be borne by the Contractor and the results of the analyses shall be furnished to the Contracting Officer. All sampling and analyses shall be performed using EPA approved methods, procedures, and holding times.

3.5.4 Sand Test

As part of each capacity test, or at the end of each intermittent pumping, a determination of the amount of sand (filter pack and/or foundation material) a well is producing shall be performed. Prior to starting the sand test all material shall be removed from the bottom of the tailpipe. The Contractor shall test each well by pumping at a rate sufficient to produce an easily measureable amount of drawdown, preferably over 3 meters. After the pump is at the desired pumping rate the flow from the discharge shall be diverted into a container that will collect all the sand being carried by the water. Development of the well is satisfactory if the amount of sand collected is less than 0.5 L per 100,000 L of water pumped at the specified rate. Upon completion of the test the amount of sand in the tailpipe shall be determined to verify that no material is being deposited in the bottom of the well.

3.6 INSTALLATION OF PERMANENT PUMP

The permanent well pump shall be installed in the well at a minimum depth of 8 m below the maximum drawdown groundwater level after the drawdown test has been completed. The pump shall be secured at the required elevation as recommended by the pump manufacturer. After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Tests shall assure that the pumping units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

3.7 DISINFECTING

After completion of tests of well, or installation of permanent pump, or at time of tests for yield and drawdown test, whichever is later, the wells shall be disinfected by adding chlorine, conforming to AWWA B301, or hypochlorite, conforming to AWWA B300, in sufficient quantity so that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and introduced into the well in an approved manner and shall remain in the well for period of at least 12 hours but not more than 24 hours. Information on methods for preparing chlorine solution and introducing it into the well may be found in AWWA C654. After the contact period, the well shall be pumped until the residual chlorine content is not greater than 1.0 ppm. The well shall be pumped to waste for an additional 15 minutes with less than 1 ppm chlorine residual after which two samples shall be taken not less than 30 minutes apart and tested for the presence of coliform bacteria. The well shall be disinfected and redisinfected as may be required until two consecutive samples of water are found upon test to be free from Coli Acrogenes group of organisms.

3.8 PUMPHOUSE AND SLAB

Pumphouse and slab shall be constructed preventing the infiltration of surface water or precipitation into the well. The slab shall be constructed of reinforced concrete. The top of the outer casing shall extend above the top of the slab. The pumphouse shall be constructed on the slab and thermally insulated.

3.9 SITE CLEAN-UP

After completion of the work, tools, appliances, surplus materials, temporary drainage, rubbish, and debris incidental to work shall be removed. Excavation and vehicular ruts shall be backfilled and dressed to conform with the existing landscape. Utilities, structures, roads, fences, or any other pre-existing item which must be repaired or replaced due to the Contractor's negligence shall be the Contractor's responsibility; repair or replacement shall be accomplished prior to completion of this contract.

3.10 SURVEYS

Coordinates and elevations shall be established for each well/test hole. Horizontal coordinates shall be determined to the closest 300 mm and referenced to the Universal Transverse Mercator (UTM). If the UTM is not readily available, an existing local grid system shall be used. A ground elevation to the closest 30 m shall be obtained at each well. The highest

point on the top of the riser pipe will serve as a measurement point. The elevation of the well shall reference this point, and shall be surveyed to the nearest 3 mm. If a recognized datum is not readily available, the existing local vertical datum shall be used. The location, identification, coordinates, and elevations of the well and monuments shall be plotted on maps with a scale large enough to show their location with reference to other structures. If no local survey reference is available, an arbitrary survey datum created for the site may be used.

3.11 WELL DECOMMISSIONING/ABANDONMENT

Any well disapproved by the Contracting Officer, or any well decommissioned/abandoned by the Contractor for any reason shall be decommissioned/abandoned according to the requirements of ASTM D 5299, and the requirements of these specifications. Well decommissioning/abandonment includes the removal of all materials left in the borehole/well, excluding the filter pack, and including backfill materials, casing, screen, and any other material placed into the hole before the decision was made to abandon the borehole/well. Test holes decommissioned/abandoned for any reason shall be grouted from the bottom to within 80 mm of the top of the ground surface according to the protocol for grout/bentonite placement established in paragraph Grout Placement, using the grout mix specified in paragraph CEMENT AND BENTONITE GROUT. The top 80 mm shall be backfilled with material appropriate for the intended land use. The Contractor shall maintain a well decommissioning/abandonment record as specified in paragraph Well Decommissioning/Abandonment Records. Groundwater levels, if encountered before the decision is made for decommissioning/abandonment, shall be measured in all borings prior to backfilling. These water levels shall be included in the well decommissioning/abandonment records. No well shall be decommissioned/abandoned without the approval of the Contracting Officer.

3.12 DOCUMENTATION AND QUALITY CONTROL REPORTS

The Contractor shall establish and maintain documentation and quality control reports for well construction and development to record the desired information and to assure compliance with contract requirements, including, but not limited to, the following:

3.12.1 Borehole Logs

A borehole log shall be completed for each boring drilled. Borehole logs shall be prepared by the geologist present onsite during all well drilling and installation activities. The log scale shall be 10 mm equals 300 mm. Copies of complete well logs shall be kept current in the field at each well site and shall be available at all times for inspection by the Contracting Officer. Information provided on the logs shall include, but not be limited to, the following:

a. Name of the project and site.

b. Boring/well identification number.

c. Location of boring (coordinates, if available).

d. Make and manufacturer's model designation of drilling equipment and name of drilling firm.

e. Date boring was drilled.

f. Reference data for all depth measurements.

g. Name of driller and name and signature of geologist preparing log.

h. Nominal hole diameter and depth at which hole diameter changes.

i. Total depth of boring.

j. Method of drilling, including sampling methods and sample depths, including those attempted with no recovery. Indication of penetration resistance such as drive hammer blows given in blows per 150 mm of driven sample tubes. Information shall include hammer weight and drop distance. Information such as rod size, bit type, pump type, etc., shall be recorded. A description of any temporary casing used, drill fluids and fluid additives used, if any, including brand name and amount used, along with the reason for and start (by depth) of its use shall be included. If measured, mud viscosities and weight shall be recorded.

k. Depth of each change of stratum. If location of strata change is approximate, it shall be so stated.

l. Description of the material of which each stratum is composed, in accordance with ASTM D 2488, and/or standard rock nomenclature in accordance with CED TR GL-85-3, as necessary. Soil parameters for logging shall include, but shall not be limited to, classification, depositional environment and formation, if known, Unified Soil Classification Symbol, secondary components and estimated percentages, color, plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, structure and orientation, and grain angularity. Rock core parameters for logging shall include, but shall not be limited to, rock type, formation, modifier denoting variety (shaly, calcareous, siliceous, etc.), color, hardness, degree of cementation, texture, crystalline structure and orientation, degree of weathering, solution or void conditions, primary and secondary permeability, and lost core. The results of any chemical field screening shall also be included on the boring log. Classification shall be prepared in the field at the time of sampling. The results of visual observation of the material encountered, and any unusual odor detected shall also be duly noted and recorded.

m. Depth of any observed fractures, weathered zones, or any abnormalities encountered.

n. Depth and estimated percent of drill fluid loss or lost circulation. Measures taken to regain drill water circulation. Significant color changes in the drilling fluid return.

o. Depth to water and date measured before, during, and after each drilling shift, and prior to well installation. The Contractor shall provide and maintain at each well under construction a portable water level measuring device of sufficient length to measure the water /NAPL level. The device shall be available onsite at all times and measuring wire shall be graduated in cm. The method of measuring the

liquid level shall be noted on the boring log. Water level measurements shall be taken to the nearest mm. It shall be noted on the boring log if the boring was purged and allowed to recover at intervals during the installation, or that water used in drilling was allowed to dissipate into the formation prior to measuring the water level.

p. Box or sample number. Depths and the number of the core boxes and/or samples shall be recorded at the proper interval.

q. Percent Rock Core Recovery. The percent core recovery for the individual drill runs, if rock is cored, shall be shown.

3.12.2 Installation Diagrams

The well will not be accepted before the geologic logs and installation diagrams are received. The diagram shall illustrate the as-built condition of the well and include, but not be limited to, the following items:

a. Name of the project and site.

b. Well identification number.

c. Name of driller and name and signature of the geologist preparing diagram.

d. Date of well installation.

e. Description of material from which the well is constructed, including well casing/riser pipe and screen material, centralizer composition, if used, diameter and schedule of casing and screen, gradation of filter pack, lithologic description, brand name (if any), source, and processing method, and method of placement of the filter pack, bentonite seal type (pellets, granules, chips, or slurry), grout type (cement or high-solids bentonite) and type of protective cover (protective casing or flush-to-ground),if used.

f. Total depth of well.

g. Nominal hole diameter.

h. Depth to top and bottom of screen, and filter pack.

i. Depth to top and bottom of any seals installed in the well boring (grout or bentonite).

j. Type of cement and/or bentonite used, mix ratios of grout, method of placement and quantities used.

k. Elevations/depths/heights of key features of the well, such as top of well casing/riser pipe, top and bottom of protective casing (if used), ground surface, the depth of maximum frost penetration (frost line), bottom of well screen, top and bottom of filter pack, and top and bottom of seal.

l. Other pertinent construction details, such as slot size and percent open area of screen, type of screen, and manufacturer of screen.

m. Well location by coordinates. A plan sheet shall also be included showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.

n. Static water level upon completion of the well.

o. Special problems and their resolutions; e.g., grout in wells, lost casing, or screens, bridging, etc.

p. Description of surface completion.

3.12.3 Well Development Records

A well development record shall be prepared for each well installed under the supervision of the geologist present during well installation operations. Information provided on the well development record shall include, but not be limited to, the following:

a. Date, time, and elevation of water level in the well, before development.

b. Depth to bottom of well, name of project and site, well identification number, and date of development.

c. Method used for development, to include size, type and make of equipment, bailer, and/or pump used during development.

d. Time spent developing the well by each method, to include typical pumping rate, if pump is used in development.

e. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.

f. Volume of water added to the well, if any.

g. Volume and physical character of sediment removed, to include changes during development in color, and odor.

h. Source of any water added to the well.

i. Clarity of water before, during, and after development. Nephelometric turbidity unit (NTU) measurements.

j. Total depth of well and the static water level as per ASTM D 4750from top of the casing, immediately after pumping/development, and 24 hours after development.

k. Name and job title of individual developing well.

l. Name and/or description of the disposal facility/area, for the waters removed during development.

3.12.4 Geophysical Logs

Geophysical logs shall be prepared and completed for each well/test hole installed. Information provided on the logs shall include, as a minimum, the following:

a. Project name.

b. Test hole/well identification number.

c. Location of test hole (coordinates, and state, and county name).

d. Date test hole was drilled.

e. Fluid level in test hole before logging.

f. Fluid type and temperature.

g. Fluid resistance in ohm-m.

h. Casing type, diameter, and elevation (top and bottom).

i. Cement type and elevation (top and bottom).

j. Screen type, diameter, and elevation (top and bottom).

k. Date and time test hole was logged.

l. Reference elevation for all depth measurements.

m. Operator's name.

n. Equipment name and address.

o. Logger type and number.

p. Tool type.

q. Detector type (Nuclear Log only).

r. Source type (Nuclear Log only).

s. Source size (Nuclear Log only).

t. Source spacing (Nuclear Log only).

u. Tool length, cable head to detector.

v. Calibration.

w. Logging speed cm/min.

x. Log vert. scale m/cm.

y. Module settings.

z. Recorder settings.

aa. Document all field problems, including equipment malfunctions. This should include the steps taken to solve the problem and how the log might have been affected.

3.12.5 Well Decommissioning/Abandonment Records

Decommissioning/abandonment records shall include, as a minimum, the following:

a. Project name.

b. Well or test hole number.

c. Well/boring location, depth and diameter.

d. Date of decommissioning/abandonment.

e. Method of decommissioning/abandonment.

f. All materials used in the decommissioning/abandonment procedure and the interval in which test materials were placed.

g. Casing, and or other items left in hole by depth, description, and composition.

h. Description and total quantity of grout used initially.

i. Description and daily quantities of grout used to compensate for settlement.

j. Water or mud level (specify) prior to grouting and date measured.

k. The reason for decommissioning/abandonment of the well/test hole.

3.12.6 Project Photographs

Before, during, and after completion of work, the Contractor shall take a minimum of one view of each well installation. If rock is cored at the site, after the core has been logged, the core shall be dampened, if it has dried, neatly arranged in the core box, and photographed. Photographs shall be 80 x 120 mm color prints. The photographs shall be mounted and enclosed back-to-back in a double face clear plastic sleeve punched to fit standard three ring binders. Each color print shall show an information box, 20 x 50 mm. The box shall be typewritten and arranged as follows:

Project No. Contract No.

Contractor/Photographer:

Photograph No. Date/Time:

Description:

Direction of View:

3.12.7 Survey Maps and Notes

A tabulated list of all wells and monuments, copies of all field books, maps showing the locations, and elevations of all wells, datum used (e.g. state plane NAD27, NAD83, UTM, etc.), elevation datum, units of measurement, and all computation sheets shall be prepared as a submittal. The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. Also, a diagram showing where on the top of the well the elevation was determined by the surveyor shall be prepared.

WATER QUALITY ANALYSIS TABLE

Physical Characteristics

Color	Resistivity in ohms per cubic centimeter and 25 degrees C.
Taste	
Threshold odor number	pH value
Turbidity	Temperature

Chemical Characteristics (Expressed as mg/L)

Arsenic	Total Hardness as CaCO(3)
Barium	Endrin
Cadmium	Lindane
Chromium	Methoxychlor
Copper	Toxaphene
Lead	2-4-D
Mercury	2, 4, 5 TP Silvex
Selenium	Total Organic Halogens
Silver	TOC
Zinc	Sulphates as SO(4)
Fluoride as F	Chlorides as C1
Manganese as Mn (dissolved and total)	Bicarbonates as HCO(3)
Iron as Fe (dissolved and total)	Carbonates as CO(3)
Suspended Solids	Nitrates as NO(3)
Total Dissolved Solids	Alkalinity (methyl-orange) (Phenolphthalein) as CaCO(3)
Calcium as Ca	
Magnesium as Mg	Silica as SiO(2)
Sodium and Potassium as Na	

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS
07/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-103	(2000) Concrete Pipe Installation Manual

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA 1-5	(2006) Pipelines

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C302	(2004) Reinforced Concrete Pressure Pipe, Noncylinder Type
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

AWWA C606	(2004) Grooved and Shouldered Joints
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation
AWWA M9	(1995) Manual: Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2005) Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250
ASME B18.2.2	(1987; R 2005) Square and Hex Nuts (Inch Series)
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 47/A 47M	(2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 563	(2004a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2006) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 74	(2006) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A 746	(2003) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C 12	(2006) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 14	(2005a) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(2005a) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 270	(2006) Standard Specification for Mortar for Unit Masonry
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 361	(2005e1) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C 361M	(2005e1) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe (Metric)
ASTM C 425	(2004) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 443M	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C 478	(2006b) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(2006b) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(2005) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(2006) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 76M	(2005b) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 828	(2006) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 923M	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 924M	(2002) Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric)
ASTM C 94/C 94M	(2006) Standard Specification for Ready-Mixed Concrete
ASTM C 969	(2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 969M	(2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 972	(2000; R 2006) Compression-Recovery of Tape Sealant
ASTM C 990	(2006) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 990M	(2006) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1784	(2006a) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(2001) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3034	(2006) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a; R 2003e1) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(2006) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(2006) Polyethylene Plastics Pipe and Fittings Materials

ASTM D 3753	(2005) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D 3840	(2001; R 2005) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM D 4101	(2006a) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 412	(1998a; R 2002e1) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 4161	(2001; R 2005) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D 624	(2000e2) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 405	(1997) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 477	(2002e1) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(2006a) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 758	(1995; R 2000) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 794	(2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2003) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for

	Sanitary and Storm Drain, Waste, and Vent Piping Applications

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames.Covers, Gratings, Steps, Sump and Catch Basin, Manhole

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

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe. Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 1.5 m outside of building walls.

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of polyvinyl chloride (PVC) plastic pressure pipe.

1.3 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4 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; G

Existing Conditions

Drawings of existing conditions, as specified.

SD-02 Shop Drawings; G

Drawings and calculations by a professional engineer showing the design and layout of the sanitary collection and treatment systems.

Installation and As-Built drawings, as specified.

Precast concrete manhole

Metal items

Frames, covers, and gratings

Details, as specified.

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports; G

Reports

Test and inspection reports, as specified.

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Gaskets

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines expected to be in contact with oil are oil resistant.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets

under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

1.6 DRAWINGS

a. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.7 EXISTING CONDITIONS

Submit drawings of existing conditions, after a thorough inspection of the area by the Contractor in the presence of the Contracting Officer. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

1.8 INSTALLER QUALIFICATIONS

Install specified materials by a licensed undergroun utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, Type PSM with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.2 PVC Plastic Pressure Pipe and Associated Fittings

2.1.2.1 PVC Plastic Pressure Pipe and Fittings

a. Pipe and Fittings Less Than 100 mm Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

(2) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 Mpa working pressure and 1.38 Mpa hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

b. Pipe and Fittings 100 mm Diameter to 300 mm: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.2.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 100 mm to 300 mm diameter, shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111/A21.11. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111/A21.11, respectively, for push-on joints and mechanical-joints.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.2 Portland Cement

Portland cement shall conform to ASTM C 150, Type II or V as applicable for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalies shall be used.

2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478M; base and first riser shall be monolithic. Manholed shall have inside diameter of 1.2 meters.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443M. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923M or ASTM C 990M.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, kPa	ASTM D 412	12,684	15,132	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, N/mm	ASTM D 624 (Die B)	49	28	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

Frames and covers shall be cast iron, ductile iron or reinforced concrete with H2O load rating. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478M. Frame shall be 750 mm inside diameter.

2.3.4.2 Manhole Steps

Steps shall be cast iron polyethylene coated conforming to 29 CFR 1910.27. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 1.2 m deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of manhole exceeds 3.6m. The ladder shall not be less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers shall be a minimum 10 mm thick and 51 mm wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.3.4.4 Septic Tank Piping

Cast iron soil pipe and fittings.

2.3.5 Sewage Absorption Field Materials

Pipe shall be perforated bell-and-spigot PVC plastic pipe conforming to ASTM F 758. Covering for open joints in drain tile lines shall be asphalt-treated paper or asphalt-covered fibrous glass cloth. Wire for fastening covering to tile shall be 1.2 mm, nonferrous metal composition.

2.3.6 Grease Trap

Grease interceptor shall be minimum 900 liter capacity single basin passive grease interceptor to prevent large amounts of pipe-clogging fats, oil, and grease and solid waste materials from entering the sanitary sewer system. The Single Basin Passive Grease Interceptor shall be designed to intercept and collect liquid greasy waste and/or garbage from the discharge piping originating from dining facilities. Flow to the interceptor shall be by gravity. Interceptor shall remove the floating and settleable wastes and prevent their interference with the proper drainage and treatment of wastewater. Interceptor shall be installed underground with top access at or above grade level and be constructed of 24 MPa concrete or mild carbon steel coated with polyurethane.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear meters.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 1.5 m from the building, unless otherwise indicated. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 3 m to a water main or service line. Install pressure sewer lines (if any) beneath water lines only, with the top of the sewer line being at least 0.60 m below bottom of water line. Where sanitary sewer lines pass above water lines or below paved or unpaved roadways, encase sewer in concrete for a distance of 3 m on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 0.9 m, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 3 m horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 3 m, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 450 mm below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 450 mm between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 450 mm between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 6.1 m, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 23 00.00 20 "EXCAVATION AND BACKFILLING FOR UTILITIES AND STRUCTURES".

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction where practical. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not

more than 7.50 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.2 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 100 mm Diameter:

(1) Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

(2) Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

(3) Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 100 mm Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings,

cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 13.80 MPa at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Absorption Field Design and Construction

Perform soil percolation or "perc" tests and size the required leach field per "AED Design Requirements: Sanitary Sewers and Septic System" dated February 2008. Grade pipe lines uniformly downward to the outlet. Lay perforated pipe with the perforations downward.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969M. Make calculations in accordance with the Appendix to ASTM C 969M.

b. Low-pressure air tests: Perform tests as follows:

(1) Clay pipelines: Test in accordance with ASTM C 828. Allowable pressure drop shall be as given in ASTM C 828. Make calculations in accordance with the Appendix to ASTM C 828.

(2) Concrete pipelines: Test in accordance with ASTM C 924M. Allowable pressure drop shall be as given in ASTM C 924M. Make calculations in accordance with the Appendix to ASTM C 924M.

(3) Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924M. Allowable pressure drop shall be as given in ASTM C 924M. Make calculations in accordance with the Appendix to ASTM C 924M.

(4) ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

(5) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

(1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

(2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4 degrees C, and shall have a surface Brinell hardness of not less than 150.

(3) Center bored and through-bolted with a 6 mm minimum diameter steel shaft having a yield strength of not less than 483 MPa, with eyes or loops at each end for attaching pulling cables.

(4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 345 kPa in excess of the maximum working pressure of the system, but not less than 690 kPa, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods. Test concrete pressure lines in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." Leakage on concrete pipelines shall not exceed 1.88 L/24 hours per mm of pipe diameter per kilometer of pipeline. Test PVC plastic pressure lines in accordance with the requirements of AWWA C605 for pressure and leakage tests, using the allowable leakage given therein.

-- End of Section --

SECTION 33 40 01

STORM DRAINAGE
07/06

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 346	(2001) Specification for Cast-in-Place Concrete Pipe

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges
AASHTO M 198	(2005) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M 294	(2006) Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter
AASHTO MP 7	(2001) Standard Specification for Corrugated Polyethylene Pipe, 1350 and 1500 mm Diameter

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(2006) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 716	(2003) Standard Specification for Ductile Iron Culvert Pipe
ASTM A 74	(2006) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM C 1103	(2003) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 1103M	(2003) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 12	(2006) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 139	(2005) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 14	(2005a) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 1433	(2006) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 1433M	(2006) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers (Metric)
ASTM C 14M	(2005a) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 231	(2004) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(2006) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(2005) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 425	(2004) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 443M	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C 444	(2003) Perforated Concrete Pipe
ASTM C 444M	(2003) Perforated Concrete Pipe (Metric)
ASTM C 478	(2006b) Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C 478M	(2006b) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 506	(2005a) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 506M	(2005a) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 507	(2005a) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 507M	(2005b) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 55	(2003) Concrete Brick
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 62	(2005) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 655	(2004e1) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 700	(2005) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(2006) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(2005b) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 828	(2006) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 877	(2002; E 2005) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 877M	(2002; E 2005) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)
ASTM C 923	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

ASTM C 923M	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 924M	(2002) Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric)
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1999) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 1784	(2006a) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2729	(2003) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(2006) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D 3212	(1996a; R 2003e1) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2006) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 1417	(1992; R 2005) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F 477	(2002e1) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(2003) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(2006a) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2003) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.2 MEASUREMENT AND PAYMENT

1.2.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe. Pipe will be paid for at the contract unit price for the number of linear meters of culverts or storm drains placed in the accepted work.

1.2.2 Manholes and Inlets

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth of up to 2 meters in the accepted work. The depth of manholes and inlets will be measured from the top of grating or cover to invert of outlet pipe. Manholes and inlets constructed to depths greater than the depth specified above will be paid for as units at the contract unit price for manholes and inlets, plus an additional amount per linear meter for the measured depth beyond a depth of 2 meters.

1.2.3 Walls and Headwalls

Walls and headwalls will not be measured. Walls and headwalls will be incidental to the work and will not be paid for separately.

1.2.4 Flared End Sections

Flared end sections will not be measured. Flared end sections will be incidental to the work and will not be paid for separately.

1.2.5 Sheeting and Bracing

No separate payment will be made for sheeting and bracing.

1.2.6 Rock Excavation

Payment will be made for the number of cubic meters of material acceptably excavated measured in the original position, and computed by allowing actual width of rock excavation with the following limitations: maximum rock excavation width, 750 mm for pipe of 300 mm or less nominal diameter; maximum rock excavation width, 400 mm greater than outside diameter of pipe of more than 300 mm nominal diameter. Measurement will include authorized overdepth excavation. Payment will also include all necessary drilling and blasting, and all incidentals necessary for satisfactory excavation and disposal of authorized rock excavation. No separate payment will be made for backfill material required to replace rock excavation; this cost shall be included in the Contractor's unit price bid per cubic meter for rock excavation. In rock excavation for manholes and other appurtenances, 300 mmwill be allowed outside the wall lines of the structures.

1.2.7 Backfill Replacing Unstable Material

Payment will be made for the number of cubic meters of select granular material required to replace unstable material for foundations under pipes or drainage structures, which will constitute full compensation for this backfill material, including removal and disposal of unstable material and all excavating, hauling, placing, compacting, and all incidentals necessary to complete the construction of the foundation satisfactorily.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Detail drawings, prepared and signed by an professional engineer for all stormwater structures and pipe, as specified.

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall conform to the requirements specified.

2.1.1 Concrete Pipe

Concrete pipe shall conform to ASTM C 76M or ASTM C 655.

2.1.2 Clay Pipe

Standard or extra strength, as indicated, conforming to ASTM C 700.

2.1.3 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.3.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.4.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 80 to 600 mm in diameter and maximum DR of 26 for pipes 650 to 1200 mm in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.4.2 Corrugated PE Pipe

AASHTO M 294, Type S or D, for pipes 300 to 1200 mm and AASHTO MP 7, Type S or D, for pipes 1350 to 1500 mm produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class in accordance with AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (mm)	Minimum Wall Area (square mm/m)	Minimum Moment of Inertia of Wall Section (mm to the 4th/mm)
300	3200	390

375	4000	870
450	4900	1020
600	6600	1900
750	8300	2670
900	9500	3640
1050	9900	8900
1200	10900	8900
1350	12000	13110
1500	13650	13110

2.1.4.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (mm to the 4th/mm)	
Nominal Size (mm)	Minimum Wall Area (square mm/m)	Cell Class 334433C	Cell Class 335434C
450	6300	850	620
525	8800	1150	840
600	9900	1330	970
675	12500	2050	1490
750	12500	2050	1490
825	14800	2640	2160
900	17100	3310	2700
1050	16500	4540	3720
1200	18700	5540	4540

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from material compatible with the piping to which it attaches

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 24 MPa concrete under Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 25 mm thick

for covers and not less than 40 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 75 mm between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar . Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478M. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.4 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6.

2.3.5 Joints

2.3.5.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443M. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 1.35 m.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443M. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.5.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877M.

2.3.5.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 178 mm wide and approximately 10 mm thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 21 mm in diameter for pipe diameters of 914 mm or smaller and 22 mm in diameter for larger pipe having 13 mm deep end corrugation. Rubber O-ring gaskets shall be 35 mm in diameter for pipe having 25 mm deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.5.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.5.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.5.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-17, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

2.3.5.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.5.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.4 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923M.

2.5 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.5.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443M. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 600 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 200 mm or 13 mm for each meter of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Clay Pipe Requirements

Bedding for clay pipe shall be as specified by ASTM C 12.

3.2.3 Ductile Iron and Cast-Iron Pipe

Bedding for ductile iron and cast-iron pipe shall be as shown on the drawings.

3.2.4 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel and Aluminum Alloy	5
Concrete-Lined Corrugated Steel	3
Ductile Iron Culvert	3
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced.

3.3.1 Concrete, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.3.5 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Manual.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 200 mm apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 13 mm, thick and the width of the diaper band shall be at least 200 mm. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If,

while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.6 BACKFILLING

3.6.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 150 mm. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.6.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 300 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 300 mm above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 150 mm.

3.6.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.6.4 Compaction

3.6.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.6.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, sidewalks, unpaved and paved parking areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.6.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922.

Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

-- End of Section --

SECTION 33 56 13

ABOVEGROUND FUEL STORAGE TANKS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B31	American National Standard Code for Pressure Piping

AMERICAN PETROLEUM INSTITUTE (API)

API Std 650	(1998; Addendum 2005) Welded Steel Tanks for Oil Storage
API Std 2000	(1998; Errata 1999) Venting Atmospheric and Low-Pressure Storage Tanks: Nonrefrigerated and Refrigerated

ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M	(2006b) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRIC CODE (NEC)

NEC 513	Article 513

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2003; Errata 2004; Errata 2006) Flammable and Combustible Liquids Code
NFPA 30A	(2003; TIA 2003) Code for Motor Fuel Dispensing Facilities and Repair Garages
NFPA 70	(2005; TIA 2005) National Electrical Code

PETROLEUM EQUIPMENT INSTITUTE (PEI)

PEI/RP200-92	Recommended Practices for Installation of Aboveground Storage Systems

UNDERWRITERS LABORATORIES (UL)

UL 142	(2006) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 674	(2003; Rev thru Apr 2006) Standard for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(2006) Industrial Control Equipment for Hazardous (Classified) Locations
UL 886	(1994; Rev thru Nov 2005) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.2 SYSTEM DESCRIPTION

Provide aboveground gasoline and diesel storage tank systems (ASTs), mechanical, electrical, control and fuel piping systems complete and ready for operation. Fuel piping systems shall include aboveground piping and connections to piping systems.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Aboveground Storage Tanks (AST); G

Submit shop drawings for each size of AST for approval. Indicate types, sizes, locations, system layout, pipe sizes, location of supports, elevations, equipment mounting, installation details, and other construction details.

Provide drawings and specifications that include the proposed conduit layout and wiring diagrams for equipment covered in this section that requires electrical connections. Indicate conduit size and material, number and size of wires, location of wiring in classified areas and location of intrinsically safe circuits and conduits.

Provide diagram for the system including a complete bill of material/equipment list.

As applicable, provide control system designs including electrical schematics, panel physical, and field wiring diagrams. Control panels shall include power conditioners.

Provide drawings of reinforced concrete tank foundation slabs. Include conduit stub up locations, and bollard spacing. Provide drawings of structural steel for walkways or pipe trestles where required.

SD-03 Equipment Submissions, and Catalog and Product Data; GA

Aboveground Fuel Storage Tanks (AST)G

Fuel Dispensing Systems

Remote Fill Station

Fuel Pumps

Fuel Piping

Instrumentation

SD-05 Calculations

Provide calculations for pump selection, pipe sizes, pipe support requirements, atmospheric vent sizing, and emergency vent sizing.

SD-06 Testing of Fuel Tanks and Fuel Pumps including instrumentation and Fuel Oil Piping; GA

The contractor shall provide the following: Six copies of each test containing the information described below (items 1-7) in bound letter-size booklets; individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible. 1) The date the tests were performed. 2) A list of equipment used, with calibration certifications. 3) A copy of measurements taken. 4) The parameters to be verified. 5) The condition specified for the parameter. 6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance the plans and specifications. 7) A description of adjustments performed.

SD-10 Installation, Operation and Maintenance Manual; GA

Installation instructions: Include Manufacturer's Instructions

Operation Data: Include installation instructions and exploded assembly views.

Maintenance Data: Include maintenance and inspection data, and replacement part numbers and availability.

Provide (4) copies of Operations and Maintenance manual. One copy shall be attached to tank in a clear PVC weather resistant document tube.

Submit Data Package 3 in accordance with Section 01 78 23 "OPERATION AND MAINTENANCE DATA".

1.4 QUALITY ASSURANCE

1.4.1 Installation

Installation shall be in compliance with the latest version of the Petroleum Equipment Institute Publications RP100, RP 200, and RP300, NFPA-30, 30A, and 31 and all manufacturers' current installation instructions.

1.4.2 Design and Construction

Comply with NFPA 30 "Flammable and Combustible Liquids Code" and NFPA 30A "Automotive and Marine Service Station Code" for design and construction, installation, inspection, and testing of fuel dispensing system components and accessories.

1.4.3 Electrical

Comply with NFPA 70 "National Electric Code" for equipment, wiring, and conduit installed under this section.

1.4.4 Label

Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

1.4.5 Welding Materials and Procedures

Conform to ASME Code and applicable regulations.

1.5 QUALIFICATIONS

1.5.1 Manufacturer

Company specializing in manufacturing the products specified in this section with minimum five years documented experience and International Fire Code Institute certified in the installation of underground/aboveground storage tank equipment.

1.5.2 Installer

Company specializing in performing the work of this section with minimum five years documented experience.

1.5.3 Workmen

Workmen who have a minimum of two years continuous experience installing this type equipment and who have attended a training seminar put on by the tank manufacturer in the past two years shall perform installation of equipment and International Fire Code Institute certified in the installation of underground/aboveground storage tank equipment.

1.6 DELIVERY AND STORAGE

Handle and store aboveground storage tanks and containment piping systems, to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 TANKS

2.1.1 Aboveground Fuel Tanks, Diesel and MOGAS Fuel for Vehicles and Generator Diesel Fuel

a. General: Provide and install aboveground tank and fuel dispensing system complete with tank, piping, gauges, fuel dispenser and other accessories specified herein. The tank shall have a total volume as noted on drawings.

b. Design Criteria: The tank system shall be designed and tested in strict accordance with UL subject 142. The UL 142 listing is for above ground tanks for flammable liquids. Numbered brass plaques issued by Underwriters Laboratories, Inc. confirming UL subject 142 approval shall be installed on the tank and be clearly visible to inspectors.

c. Tank Construction: - Internal Steel Tank

(1) Furnish and install a 6,000 gallon aboveground, horizontal, single-wall, steel storage tank 8'0" inches in diameter by 16'0" long. Tank shall be fabricated from mild carbon steel with flat-flanged heads. Tank gauges: head gauge 1/4", shell gauge 1/4". All items included with the tank shall be coated with red primer and white urethane paint. The tank shall be manufactured in conformance with Underwriters Laboratories' UL-142 specifications and so labeled.

The tank shall be fabricated with the threaded connections as indicated and as located on attached drawing. Thread protectors shall be inserted in all threaded openings prior to shipment.

Tanks shall be air tested at the factory but MUST be retested at the jobsite by the installer prior to installation.

Tank shall be fitted with the following options & accessories:

Loose-bolt Manway ___ inches in diameter with bolted and gasketed lid (emergency vent)
Support Saddles
External Ladder
Pump Platform
Level Sensing System(s)

Warranty:

Tanks shall be warranted by manufacturer to be free from defects in manufacturing, workmanship and materials. Manufacturer shall repair or replace, at its sole discretion F.O.B. factory, within a period of one year after date of shipment, any item of its manufacture. All other items shall be warranted by their respective manufacturers. Liability hereunder is limited, as stated above, and does not include labor, installation costs, indirect or consequential damages of any kind. Tanks must be returned to the factory and if found to be defective upon examination, will be repaired, replaced or credit will be issued at our option.

(2) Tank shall comply with the normal and emergency venting requirements of NFPA 30.

(3) Tank shall carry a thirty-year written warranty including materials and workmanship.

d. Tank Appurtenances: The tank manufacturer shall provide the following integral components.

(1) Saddles: Tank shall have integral seam welded tank saddles in accordance U.L. Standard 142 designed to support the full load of tank and contents. Saddles shall provide for a minimum 152 mm (6")clearance between tank and pad for complete visual inspection. The tank support system shall be anchored to concrete pad to protect from floatation. Saddle anchors shall be as provided by tank manufacturer.

e. Access Ladders: Tanks shall be equipped with ladders as indicated on the drawings. Ladders shall be of welded steel construction with prime and finish paint of industrial enamel. Ladders shall be designed to conform to OSHA requirements. Steps shall include non-skid tread surfaces, handrails, platforms, and kick plates as required for OSHA compliance.

f. Venting: Provide properly sized U.L. listed and C.A.R.B. approved emergency and standard vents to satisfy code requirements. Standard vent shall terminate a minimum of 3.66 m above the adjacent ground level.

g. Grounding: A grounding cable, clamp, and ground rod shall be provided by tank manufacturer and installed by contractor. System shall be electrically grounded in full compliance with N.F.P.A. 78 standards for static electricity build up. Clamp shall be attached to base of vent riser prior to finish painting.

h. Exterior Finish: The complete tank system shall include a urethane based high gloss white exterior finish. The final coat shall be a clear fuel resistant coating. Color of finish to be selected by Government.

i. Environmental Protection: All service fittings shall have 305 mm x 305 mm gauge/deflector plates under them on bottom of tank.

2.2 TANK ACCESSORIES

2.2.1 Accessory Equipment For ASTs - Generator Diesel Fuel

The following accessory equipment shall be provided as part of the pre-engineered tank and coordinated with each tank design: Direct read tank

level gage, direct read leak gage, inspection port adapter cap, and tank fill system.

Anti-spill Valves: Where product piping extends below the top of the primary tank, piping shall include shutoff valve and a normally closed safety valve; safety valve shall be an approved anti-siphon valve or an electric solenoid valve.

2.2.1.1 Direct Read Leak Gauge

Tank shall be equipped with a direct reading leak gauge with aluminum housing, calibration assembly, red HDPE plastic indicator tube, float arm assembly. Krueger Sentry Gauge At-A-Glance leak gauge or engineer approved equivalent.

2.2.1.2 Direct Read Level Gauge - High Level Alarm

Tank shall be equipped with a direct reading level gauge with aluminum housing. The level gauge shall have metric face and be readable from ground level. Provide gauge with re-settable built-in high level warning alarm(at 95% capacity). Alarm shall be battery powered, intrinsically safe, and mounted remote from gauge. Morrison Model #918 or engineer approved equivalent.

2.2.1.3 Direct Read Level Gauge - Low Level Alarm

Provide an audibel alarm for low level warning. System shall incorporate an alarm box and single-point level sensor. Alarm box shall be weatherproof, intrinsically safe with a 90 decibel alarm (at 10% capacity). Alarm shall operate on two 9-volt batteries and feature a membrane-type test/cancel button. Morrison Model #918TCP or engineer approved equivalent.

2.2.1.4 Overfill Protection Valve

Provide valve to terminate flow of product when liquid level reaches preset warning level. Morrison Model 9095A or engineer approved equavilent.

2.2.1.5 Remote Fill System

Each tank shall be provided with a fill container designed to minimize and contain fuel spilled when disconnecting the delivery fitting during normal tank filling operations. The interior shall be prime coated and painted with durable white urethane to aid in visual product leak inspection. Total leak containment shall be 57 litre and shall be provided with drain connection and lockable valve. Provide for capability for fuel delivery from outside the wall around the compound. The remote fill station shall be lockable and securable from tampering and sabotage.

2.2.1.6 Product Label Marker

Stainless Steel band clamp with API color-coded plaque for product being stored.

2.2.1.7 Decal/Placard

Provide decal or placard affixed to the tank fill box that gives a detailed, step-by-step tank filling procedure as well as the tank calibration chart.

The decal or placard must be readily visible during tank filling operations and must be of a material that does not deteriorate when exposed to weather.

2.2.2 Accessory Equipment For ASTs - Vehicle Diesel Fuel and MOGAS

The following accessory equipment shall be provided as part of the pre-engineered tank and coordinated with each tank design: Direct read tank level gage, direct read leak gage, inspection port adapter cap, and tank fill system

2.2.2.1 Inspection Port Adapter Cap

Tank shall be equipped with a 100 mm adapter and lockable cap for inspection and manual gauging of fuel level. Gauge port shall be accessible from steps or ladder.

2.2.2.2 Line Purging Valve

Carbon steel, stainless ball, with Viton seals.

2.2.2.3 Spill Sump Drain Valve

Tied into suction side of pump. Carbon steel, stainless ball, with Viton seals.

2.2.2.4 Ground Stud

Provide labeled ground stud for connection of static bonding cable

2.2.2.5 Operating Valve

75 mm Stainless steel ball valve.

2.2.2.6 Check Valve

Iron body, Viton seals.

2.2.2.7 Overfill Prevention Valve

Installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 152 mm of the tank bottom. Valve shall be rated for pressurized fuel delivery. Valve shall include integral vacuum breaker for siphon prevention. Size as shown on drawings.

2.2.2.8 Fuel/Vapor Recovery Piping

Pre-piped tank piping shall be 304L Stainless Steel Schedule 10 belled fitted fittings and pipe connections are ANSI 150# RF Flanged W/ #5 bolts, nuts and stainless washers on both flange sides or Victaulic roll grove couplings.

2.2.2.9 Disconnect Coupling

Stainless steel assembly with dust cap for supply delivery connection. Fitting shall be coordinated with fuel supplier to assure compatibility. Installed fitting shall be at 45 degree angle pointing upward to minimize drips. Fitting shall include 40 mesh stainless steel cone strainer.

2.2.2.10 Product Label Marker

Stainless Steel band clamp with API color-coded plaque for product being stored.

2.2.2.11 Decal/Placard

Provide decal or placard affixed to the tank fill box that gives a detailed, step-by-step tank filling procedure as well as the tank calibration chart. The decal or placard must be readily visible during tank filling operations and must be of a material that does not deteriorate when exposed to weather.

2.3 FUEL DISISPENSING SYSTEM FOR DIESEL AND MOGAS

The tank shall be provided with tank manufacturer's standard cataloged product designed and UL listed for service in the fuel indicated and subject to the compliance with the following requirements; for each system, provide the following:

2.3.1 Pump

Configuration: Pump & meter/register combination with integral vacuum breaker and vapor return tubing

Performance: Up to 20 GPM'. Minimum dry vacuum - 15" of mercury.

Compatibility: For dispensing low viscosity petroleum fuels diesel, including biodiesel blends up to 20%; kerosene; and gasoline, including standard oxygenated blends. Fuel must meet the applicable ASTM standard. Not for refueling aircraft.

Meter Register: 4-wheel register (up to 999.9 gallons). Knob reset. 7 -digit (with tenths) non-resettable accumulative totalizer. Phenolic resin nutating disc metering chamber. Accuracy ±.5% at full flow. Adjustable calibration range for different fuel types. Die-cast aluminum housing.

Pump Assembly: Self-priming, rotary vane pump. Cast iron construction for long life. Sintered iron rotor with 8 carbon graphite vanes. Fiber key connection to motor shaft. Key breaks in the event an obstruction impedes the turning of the motor shaft.

Motor & Electrical: l/3 HP intermittent duty with thermal overload protection. Direct-drive. Explosion-proof. 115VAC 60Hz.

Junction Box: Weatherproof o-ring seal. AC auxiliary line for remote solenoid valve control. External motor switch in separate internal compartment. Die-cast aluminum construction.

Strainer Assembly: Combination strainer and spring-loaded check valve with pressure relief assembly. Cast iron housing.

Anti-Siphon Valve: Integral vacuum breaker in meter discharge. Duckbill design. Copper tubing returns any drips back to tank through fitting in strainer base.

Nozzle Boot: Zinc-plated steel. Protects nozzle from rain and dirt. Accommodates standard automatic and manual nozzles without the need for spout hooks. Easy on/off lever prevents nozzle storage in on position. Nozzle can be padlocked to prevent unauthorized use.

Mounting inlet: 2" NPT male at base of strainer assembly for tank mounting. 1" NPT female suction tube inlet.

Discharge: 1" NPT female at pump. With meter/register assembly, choice of (2) 1" NPT female outlets - top or back. Plug included for unused position.

Finish: Pump and meter painted with blue polyurethane enamel. Meter/register has a black UV-resistant lexan dial face graphic.

Pressure: Working pressure up to 50 psi.

Approvals: ETL &. c-ETL Listed (conforming to UL 79, 674, and 1203 and certified to CSA Standard C22.2 No's. 145-M1986, 30-M1986, and 22-M1986). 700R Register: UL Listed

2.4 PRODUCT DISPENSERS - PRESSURIZED SUPPLY FOR DIESEL AND MOGAS

2.4.1 General

Dispenser:

Includes the following options as standard: 1" piping, j-box [J], solenoid valve.

Performance: Up to 22 GPM (83 Ipm)*.

Compatibility: For dispensing low viscosity petroleum fuels - diesel; blodiesel blends up to 20%; gasoline, including oxygenated blends; kerosene; AvGas and jet fuel. Fuel must meet the applicable ASTM standard.

Note: Confirm with fuel supplier on any fluid path metal restrictions before use. If aluminum, zinc, or red metals are not desired, use appropriate option.

Register: Non-computer mechanical register with power reset with interlock. Up to 999.9 gallons per delivery. Non-resettable accumulative totalizer up to 9999999.9. Optional liters measure.

Meter: Reliable micro-accurate 2-piston positive displacement design. Weights & Measures sealable.

Solenoid Valve: 1" (2.5 cm) two-stage valve. Single stage valve.

Electrical: 115VAC, 60 Hz. Optional 230VAC 50/60 Hz operation.

Inlet Connection: 11/2." (3.8 cm) NPT. Bottom access hole sized for 1 1/2 emergency valve installation.

Discharge: 1" (2.5 cm) with 3/4" reducing bushing.

Mounting: Four 7/16" (1.1 cm) mounting holes in bottom with optional shelf-mount kit.

Cabinet Construction: All panels are fabricated from galvannealed steel for corrosion resistance. Front door includes lock and is removable for service. Outer sides, back, and top are removable for additional service access if required.

Cabinet Finish: Extremely durable powder-coated finish to give outstanding appearance and toughness. Metallic silver sides, top, and back. Blue door with black register decal. Optional black, brown, green, red, silver, yellow, or white doors.

Nozzle Boot and Hook: To fit standard UL interchangeable nozzles. Also to fit Emco Wheaton 4015 and Husky V short spout balance vapor recovery nozzles. Hook extension kits for OPW 11 VF (p/n 892081-001) and Healy 400 (p/n 892080-001) long spout vapor recovery nozzles. Lift-start nozzle hook. Provide nozzle as per owner's requirements.

Hose Hanger: Keeps hose off ground when not in use.

Approximate Dimensions: 30.25"H x 16.75"W x 14"D
(76.8cm H x 42.5cm W x 35.6cm D)

Pressure: Working pressure up to 50 psi.

Approvals: C-UL-US Listed. Sealable by U.S. Weights & Measures.

Nozzle: Diesel Husky High Flow Model Number 173310
MOGAS Husky Model Number 159404-04

Hose: Goodyear 1" Fuel Hose, malexmale - compatible with fuel used.

Options:

Shelf-Mount Kit: Carbon steel shelf brackets for mounting dispenser to tank. Black powder coat finish.

Hose Mast: Raises hose to ease hose handling.

External Filter Kit: Installs on discharge.

Liter measure and 230VAC 50/60 Hz operation.

Verify with owner if vapor recovery is required.

2.4.2 Breakaway Coupling

Catlow, Inc., Husky Corp., Richards Industries, coupling separation at 200 pounds maximum pulling force; integral flow preventing seals or valves activated upon coupling separation. U.L. listed and labeled to retain U.L. rating after separation. Husky Model 2200 or equal. Include a 150 mm whip hose at dispenser.

2.5 PRE-PIPED TANK FUEL DISTRIBUTION PIPE AND FITTINGS - DIESEL AND MOGAS

2.5.1 Accessory Equipment

Ball Valves: Stainless steel two-piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

2.5.2 Dielectric Connections

Provide dielectric connections at piping connections of dissimilar metals.

2.6 ELECTRICAL REQUIREMENTS

Provide switches and devices necessary for the tank electrical systems system; wiring, fittings, and components shall be explosion-proof in compliance with applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division l, Group C and D hazardous locations. Electrical installations shall conform to requirements of NFPA 70.

2.6.1 Wiring

All wiring shall be designed and installed in strict accordance with NFPA 70.

2.6.2 Tank System

Tank system shall be factory pre-wired and supplied with remote mounted NEMA 7 emergency stop control panel. Panel to be equipped with means of disconnecting all fueling system circuits per NFPA 70 -514.

2.6.3 Panel

System shall include branch circuit panel board, pump motor starter, disconnect relays, pump running indicator, panel disconnect, with maintained mushroom head push button.

2.6.4 Feed

System shall require only one 230V Single Phase 30 amp feeder from main distribution panel. Provide by others.

2.6.5 Enclosure

NEMA 7 explosion-proof.

2.6.6 System Connection

Connect to tank with a single explosion proof UL Listed and CSA Approved for Class I, Groups B, C, D, Divisions 1 and 2 direct burial multiple conductor cable. Conductors shall be color coordinated with control panel and tank connections.

PART 3 EXECUTION

3.1 EXCAVATION

3.1.1 Excavation, Trenching, and Backfilling

See Division 31.

3.2 FUEL TANK INSTALLATION.

3.2.1 Installation

Install tanks in strict accordance with the manufacturer's recommendations, PEI/RP200-92, and applicable fire and environmental codes.

3.2.2 Aboveground Tank Markings

Tank shall be clearly marked on all sides with warning signs: "FLAMMABLE" or "COMBUSTIBLE", "NO SMOKING", tank volume, product identification (Diesel or Mogas), and other signs as required by the applicable codes.

3.2.3 Electrical Work

Perform in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded in accordance with NFPA 78.

3.2.4 Inspection

Tank installation shall be inspected and approved using services of the tank supplier or its certified contractor. Submit a comprehensive checklist of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes from tank supplier.

3.3 TANK LEAK AND LEVEL GAUGE INSTALLATION

3.3.1 General

Install in strict accordance with the manufacturer's recommendations, National Electrical Code NFPA 70, and NFPA 30A.

3.3.2 Electrical

Electrical work shall be rated for hazardous area as required.

3.3.3 Tank Level and Leak Mechanism

Install the tank level mechanism and the interstitial leak mechanism in the proper locations in the fuel tank.

3.4 ELECTRICAL SYSTEM

3.4.1 Wiring

Design, provide and install all branch circuit conduit and wiring for equipment installed in this section. Design and install wiring in strict accordance with NFPA 70.

3.5 FIELD TESTING

Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a calibrated test gage in the system. Maintain test pressure for at least one hour on all new piping work. In the event of leakage, locate and repair leak and repeat test. Submit a field acceptance test report for each new AST system installation and each new piping system installation.

3.5.1 Piping System Test

After tank erection and installation of valves and piping, test piping. Perform hydrostatic test of new fuel piping work at27 kPa per mm (gage)for one hour. Replace defective material disclosed by pressure test and repeat test until results are satisfactory.

3.5.2 Storage Tank Test

Pressure test tanks at not less than 1.4 kPa per mm (gage)or more than 1.9 kPa per mm (gage) and as recommended by the manufacturer.

3.5.3 Testing Fuel Distribution System

Test fuel distribution system according to NFPA 30. Replace leaking joints and connections with new materils.

3.5.4 Reports

Submit reports of tests and procedures.

3.6 COMMISSIONING

Before activating the system perform these steps:

Flush system piping with grade of fuel to be used by owner to remove any debris and foreign matter in piping prior to filling tank for the first time. Service all system filters and screens and dispose of fuel in accordance with EPA and NFPA regulations after flushing.

Open valves to correct position for system operation.

3.7 INSTRUCTION TO GOVERNMENT PERSONNEL

Furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the AST system, accessories for the AST, and the associated piping system. Instruction shall be given during the a regular work week after the equipment or system has been accepted and turned over to the Government for regular operation.

Schedule instruction time with Contracting Officer. The number of man-days (8 hours per day) of instruction furnished shall be one-half. Use approximately half of the time for classroom instruction. Use other time for instruction in the field at the equipment or system.

-- End of Section --

SECTION 33 56 13.14

FIBERGLASS-PLASTIC LINING FOR STEEL TANK BOTTOMS (FOR PETROLEUM)
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z9.4	(1997) Abrasive Blasting Operations: Ventilation and Safe Practices for Fixed Location Enclosures

ASTM INTERNATIONAL (ASTM)

ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5	(2007) White Metal Blast Cleaning
SSPC SP 7	(2007) Brush-Off Blast Cleaning
SSPC SSPM	(2000) SSPC Painting Manual, Volume 2, Systems and Specifications

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-22262	(Rev B; Am 2) Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-P-24441	(Rev C; Supp 1; INT Am 1) Paint, Epoxy-Polyamide
MIL-PRF-4556	(Rev F; Am 1) Coating Kit, Epoxy, for Interior of Steel Fuel Tanks
MIL-PRF-680	(Rev B) Degreasing Solvent

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS O-D-1276	(Rev B) Disinfectant-Detergent, General Purpose (Pine Oil)

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

29 CFR 1910.1200	Hazard Communication
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][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

Primer

Polyester resin system

Fiberglass mat

Fiberglass cloth

Epoxy resin binder

Blast cleaning abrasive

Submit data for the materials to be used. The data shall include brand names, catalog numbers, names and addresses of manufacturers.

SD-06 Test Reports

Blast cleaning abrasive

Submit report on type, size, and hardness of abrasive selected for blast cleaning together with laboratory test data to verify that the abrasive to be used conforms to the size and hardness requirements.

SD-07 Certificates

Primer

Fiberglass mat

Fiberglass cloth

Epoxy resin binder

Sand

Detergent

Solvent

Qualifications of contractor's representatives

Qualifications of manufacturer's representatives

Equipment list

SD-08 Manufacturer's Instructions

Primer

Polyester resin system

Fiberglass mat

Fiberglass cloth

Epoxy resin binder

Blast cleaning abrasive

Submit detailed mixing and application procedures. Submit material safety data sheets for materials to be used at the job site in accordance with 29 CFR 1910.1200.

SD-11 Closeout Submittals

Abrasive treatment or disposal manifest

1.3 DELIVERY AND STORAGE

1.3.1 Delivery

Deliver materials to the job site in the original packages or containers with each bearing the brand name, applicable standard designation, catalog number, and name of manufacturer.

1.3.2 Storage

Keep materials dry and protected from extreme temperatures by storage under cover and away from direct exposure to rain, heat, or other extreme weather conditions.

1.4 QUALITY ASSURANCE

1.4.1 Contractor's Representatives

Submit names and qualifications of each Contractor's representative who will be in charge of the work and who will be present at the job site when the work is being accomplished.

1.4.2 Manufacturer's Representatives

Submit the name and qualifications of the resin manufacturer's representative who shall be present during the initial phase of the lining application to insure that the manufacturer's mixing and application procedures are understood and are being followed. The manufacturer shall certify in writing that the representative is a regular employee and is qualified and experienced in the type of lamination work to be performed.

1.5 EQUIPMENT

1.5.1 Equipment List

Submit a complete list of equipment, with adequate description by item, that will be used at the job site.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Primer

Green epoxy-polyamide, MIL-P-24441, epoxy-polymide green primer or epoxy primer, MIL-PRF-4556, Composition [G] [L].

2.1.2 Polyester Resin System

2.1.2.1 Polyester Resin

One of the following chemical resistant polyester (including vinyl ester) resins, or equal: Derakane 411-45 (Dow Chemical Company), Atlac 4010A (Koppers Company, Inc.), Dion Cor-Res 7000A (Koppers Company, Inc.).

2.1.2.2 Catalyst and Promoter

Use the catalyst and promoter solutions and proportions of each recommended by the resin manufacturer.

2.1.2.3 Additives

Thixotropic materials, paraffin wax for the air-exposed surface coat only, and other additives recommended by the resin manufacturer, in the amounts specified by the resin manufacturer.

2.1.3 Fiberglass Mat

Type E glass, Silane sized chopped strand reinforcing mat with a high solubility binder, 0.46 kg per square meter.

2.1.4 Fiberglass Cloth

Type E glass, plain weave cloth with a Silane finish, 0.34 kg per square meter, 16 x 14 thread count, 150-4/2 warp and filling yarn.

2.1.5 Epoxy Resin Binder

ASTM C 881/C 881M, Type III (for surfaces subject to thermal or mechanical movements), Grade 2 (Medium viscosity) or Grade 3 (Non-sagging consistency), [Class B, for use between 5 to 15.6 degrees C [or,] [Class C, for use above 15.6 degrees C, with filler.

2.1.6 Sand for Mortar or Putty

ASTM C 33/C 33M, uniformly graded from coarse to fine with no more than 5 percent passing the 150 micrometers sieve.

2.1.7 Blast Cleaning Abrasive

MIL-A-22262. Select abrasive material, particle size, and hardness in accordance with SSPC SSPM Volume 2, Surface Preparation Commentary to produce the required surface condition. Do not use sand or organic abrasives such as walnut shells.

2.1.8 Detergent

FS O-D-1276.

2.1.9 Solvent

MIL-PRF-680, Type II, minimum flashpoint of 60 degrees C.

2.2 MIXES

2.2.1 Polyester Putty

Catalyzed polyester resin, thixotropic material, and sand. Use proportions recommended by the manufacturer of the polyester resin to form a putty consistency.

2.2.2 Epoxy Resin Mortar

Epoxy resin binder adhesive system and sand. Mix small trial batches to determine proper mortar consistency.

PART 3 EXECUTION

3.1 SAFETY, FUEL REMOVAL, AND TANK CLEANING

Safety procedures, fuel removal, and tank cleaning shall be in accordance with Section 33 65 00 CLEANING PETROLEUM STORAGE TANKS. Insure that personnel are advised of the information contained in the Material Safety Data Sheets (MSDS) for the products to be used for protection against toxic and hazardous chemical effects. Blank-off or disconnect incoming fuel lines. Follow the applicable precautions in AIHA Z9.4 during abrasive blasting.

3.2 INSPECTION

Prior to starting any work, verify that the tank and connecting lines have been emptied of fuel and that the tank has been adequately cleaned.

3.3 VENTILATION

Throughout the course of the work, provide ventilation as required for producing a vapor-free condition, for adequate removal of solvent vapors and toxic hazards, and for curing the coatings. Use exhaust-type fans, either explosion-proof electrically operated or air-driven, and of sufficient capacity to hold the vapor concentration below 4 percent of the lower explosive limit. Attach noncollapsible, noncombustible flexible ducts to the fans. The ducts shall be of sufficient length to reach the bottom of the tank and extend to the work areas. Keep fans in operation whenever workmen are in the tank and whenever necessary for proper cure of the lining system materials.

3.4 WEATHER CONDITIONS

Perform abrasive blasting, surface repair, and lining application only when the ambient temperature is between 10 and 32 degrees C and the steel surface temperature is more than 3 degrees C above the dew point temperature of the surrounding air. Surface repair and lining work shall not be done on damp or wet surfaces or while there is any precipitation.

3.5 TEST PANELS

After the tank is cleaned, inspect the tank walls and select steel plate with similar characteristics and surface profile for use as test panels. Abrasive blast one or more 0.093 square meter test panels to white metal in accordance with SSPC SP 5 using the same abrasive that will be used on the tank. Record the blast nozzle type and size, air pressure, distance of nozzle from plate, and angle of blast to establish procedures for blasting to develop a 0.075 to 0.10 mm anchor pattern. Use a Keane-Tator surface profile comparator, appropriate to the abrasive being used, to determine the profile of the test panels before and after the white blast test. Keep the test panels wrapped and sealed in vapor tight material for use as a standard of comparison for the steel surfaces throughout the course of the work.

3.6 INITIAL ABRASIVE BLAST

Perform brush-off blast cleaning in accordance with SSPC SP 7 of the steel surfaces to be lined including 600 mm up on the tank wall and columns. Use conventional air, force-feed, or pressure type blasting equipment. Water or vapor blast is not permitted. Provide filtered air supply, free of oil and moisture. After abrasive blasting, remove loose sand and dust from the surfaces by brushing, blowing with dry compressed air, or vacuuming, and then remove loose material from the tank interior.

3.7 SURFACE REPAIR

Following cleaning and initial abrasive blasting, inspect the surfaces to be lined for defects requiring repair. Total area of repairs is estimated to be [_____] square meters. Repair perforations, cracks, or splits by welding. Plate edges or welds shall be ground smooth with a minimum radius of 3 mm. Remove weld spatter. Fill voids, pits, or other surface imperfections with

epoxy resin mortar or polyester putty conforming to the paragraphs entitled "Epoxy Resin Mortar" or "Polyester Putty." Make the repair even with the adjacent steel surface and carefully remove excess material so that none remains spread on the adjacent surface.

3.8 COVES

Clean out the existing ring joint where the tank wall meets the tank floor and repack with either epoxy resin mortar or polyester putty conforming to the paragraphs entitled "Epoxy Resin Mortar" or "Polyester Putty." Form new coves, using the same material, around the ring joint and around the base of columns and other 1.57 rad corners. Form the coves so that the exterior surface slopes at a 0.785 rad angle and the sides of the cove are a minimum of 75 mmlong.

3.9 SECOND ABRASIVE BLAST

Following completion of the surface repair and hardening of the resin surface fillers, give a white metal blast in accordance with
SSPC SP 5 to the surfaces to be lined. The abrasive blast shall provide a "tooth" or anchor pattern of 0.075 to 0.10 mm on the surfaces for proper adhesion of the lining system. Abrasive blasting and cleanup shall be as conducted for the initial abrasive blast.

3.10 DISPOSAL OF USED ABRASIVE

Determine if the used blast cleaning abrasive is a hazardous waste in accordance with 40 CFR 261. Handle and dispose of abrasive determined to be hazardous waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265.Dispose of abrasive which is not hazardous waste at a landfill off Government property in accordance with applicable regulations. The contract price will be adjusted for disposal of the used abrasive determined to be hazardous waste. However, payment for disposal of hazardous waste will not be made until a completed manifest from the treatment or disposal facility is returned, and a copy is furnished to the Government. If a laboratory sample is required to be analyzed, provide the results to the Government along with the manifest.

3.11 TANK LINING

Line the entire tank bottom and up 600 mm on the tank wall and columns including abrasive blasted surfaces with a fiberglass reinforced plastic laminate system. The complete lining system shall consist of an epoxy primer, a coat of polyester resin, layers of polyester-impregnated fiberglass mat and fiberglass cloth, and a top coat of paraffinated polyester resin. Use sufficient alternating layers of fiberglass mat and cloth to provide a cured-laminate minimum thickness of 3 mm and a fiberglass mat bottom and top layer.

3.11.1 Primer

Allow no more than 8 hours to elapse between the second abrasive blasting of the steel surfaces and application of the epoxy primer. Apply the primer by spray or brush to give a dry film thickness of not less than 0.05 mm. Provide a cure time of at least 4 but not more than 24 hours before application of the first coat of polyester. If 24 hours are exceeded before

application of the polyester, lightly abrasive blast the surface again, clean up, and apply another coat of primer.

3.11.2 Polyester Resin

Determine that the primer is dry to the touch before applying the first coat of polyester. Insure that surfaces are dry and free from condensate or moisture before applying the polyester resin. Where natural or forced air circulation does not achieve dry conditions, circulate heated air through the tank to dry the surfaces. Mix the polyester resin with the catalyst, promoter, and additives in conformance with the proportions provided in the resin manufacturer's written instructions. Mixes may vary when necessary to suit ambient temperatures and surface conditions in the tank. Do not mix the materials until the coating is ready to be used and mix only the quantity that can be properly applied during the pot life of the resin system. Mix the promoter and catalyst separately into the resin in accordance with the resin manufacturer's instructions; never mix the promoter and catalyst together or add both to the resin without mixing one completely into the resin before adding the other, as an explosion or fire could result.

3.11.2.1 First Coat

Spray, roll, or brush the first coat of the resin system onto the primed surface until the surface is thoroughly wet but the resin is not running. Place a layer of fiberglass mat over the wetted surface and roll or knead the mat in both directions to remove wrinkles and air bubbles and to wet the mat with the resin. Brush and roll additional resin onto the mat where areas appear dry or not thoroughly wet. Carefully mold the resin-wetted mat around the columns and extend up the columns and tank wall a distance of 600 mm. Each new area covered shall overlap the preceding area with a 50 to 75 mm seam. Lapped edges of adjacent layers shall be staggered.

3.11.2.2 Second Coat

Spray, roll, or brush the second coat of the resin system onto the mat. Place a layer of fiberglass cloth on the wetted mat and roll or knead the cloth to remove wrinkles and air bubbles and to impregnate the cloth with the resin. Apply additional resin as required to insure that all areas of the cloth are wet. Overlap the cloth and mold-up the columns and walls as was done with the mat.

3.11.2.3 Additional Coats

Apply additional coats of the resin system with alternating layers of mat and cloth in the same manner indicated for the first and second coats as needed to provide the required laminate thickness. Use a layer of mat as the top layer of the laminate.

3.11.2.4 Top Coat

Add paraffin wax to the resin system to be used for the top coat to prevent air inhibition. The amount of paraffin and its manner of addition to the resin shall be in accordance with the resin manufacturer's recommendations. Apply the paraffinated resin system over the entire laminate surface by spray, brush, or roller to a thickness of not less than 0.25 mm. Care shall be taken not to use the paraffinated resin system in the lamination work.

3.11.2.5 Cure

Allow the lining system to cure until it is no longer sticky or soft to the touch. If the ambient temperature is below 15.6 degrees C, circulate warm air in the range of 15.6 to 27 degrees C over the coated areas during the curing period. In no case shall the tank be put back into service until a minimum of 10 full days have elapsed from the time of completion of the lining work.

3.12 FINAL INSPECTION AND TESTS

Following completion and cure of the lining system, arrange with the Contracting Officer for an inspection of the lining visually and by holiday detector test and for air inhibition testing. Repair pinholes, cracks, voids, bubbles, delaminations, inadequate lining thickness, poor adhesion, or other imperfections so designated by the Contracting Officer.

3.12.1 Air Inhibition Test

Perform the air inhibition test on areas of the lining system selected by the Contracting Officer. Apply several drops of acetone to the laminate surface and rub the acetone with the fingers until it evaporates. If the surface becomes softened or tacky, it is evidence of undercure. When undercure is found, circulate warm air again over the coated areas until retest indicates no softening or tackiness.

3.12.2 Holiday Detector Test

While visually inspecting the lining, conduct holiday testing on the lined steel surfaces using a high frequency spark type holiday detector.Set the voltage output at 10,000 volts. Use a detector equipped with an audible signal device to indicate imperfections in the lining, and conduct the test in accordance with the printed instructions of the detector manufacturer. Repair holidays or imperfections by lightly sanding and applying an additional top coat.

3.12.3 Fill Test

After the work has been completed, inspected, and approved, the tank shall be fill tested. Remove the blind flanges and reconnect tank piping ready for service. The Government will fill the tank with fuel, providing the necessary fuel and labor. Advise the Contracting Officer in writing at least 10 days in advance of the need for this service. Fill tank half full with fuel, check that drain valves are closed, and check tank for leaks. Keep tank half full the first 12 hours of test, then fill to full capacity. Check again that drain valves are closed and tank does not leak. Monitor the fuel level hourly during the first 24 hours of the fill test and then daily for the next 9 days with measurements taken at the same time each day. Use a measuring rule with at least 3 mmcalibrations. Padlock drain valves closed for the duration of the test and provide one set of keys to the Contracting Officer. Notify the Contracting Officer immediately of any leaks detected. If there is no measurable drop in the fuel level during the test period, the tank will be accepted. If leakage is detected, Government personnel will then pump the fuel from the tank. When empty, clean the tank, make it vapor free, and obtain written certification from the NFPA certified "Marine Chemist" or "Gas Free Engineer" that the tank is "safe for entry" and "safe for hot work" in accordance with Section 33 65 00 CLEANING PETROLEUM STORAGE

TANKS. Carefully inspect the lining for evidence of failures or other possible sources of leakage. Repair defects found in the lining and repeat tests.

3.13 CLEANUP

After the work and testing have been completed, remove debris, equipment, and materials from the site. Remove temporary connections to Government water and electrical services. Restore existing facilities in and around the work area to their original condition.

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C42.100	(2000) Standard Dictionary of Electrical and Electronics Terms

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(2001) Standard Specification for Soft or Annealed Copper Wire

FM GLOBAL (FM)

FM P7825a	(2005) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA C80.1	(2005) Standard for Electrical Rigid Steel Conduit (ERSC)

NEMA FB 1	(2003) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA PB 1	(2006) Standard for Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 467	(2004) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; Rev thru Aug 2006) Standard for Wire Connectors
UL 489	(2004; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(2005) Standard for Metallic Outlet Boxes
UL 6	(2004e13) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005e7) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in ANSI C42.100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions.

a. Altitude 19,686 m.

b. Ambient Temperature +50 degrees and -40 degrees C.

c. Frequency 50 hz

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Detail Drawings
As-Built Drawings

Drawings, as specified.

SD-03 Product Data

Nameplates; G

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment; G

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Requirements; G

SD-06 Test Reports

Factory Tests

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests

Six copies of the tests report in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

Cable Installation

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly,

installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS O5.1. Handling of wood poles shall be in accordance with ATIS O5.1, except that pointed tools capable of producing indentations more than 25 mm in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

1.6 DRAWINGS

1.6.1 Detail Drawings

The Contractor shall submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

1). Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

2). Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

1.6.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.3 CORROSION PROTECTION

2.3.1 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 Jackets

Cables shall be provided with a polyethylene jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to NEMA C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be nonencased direct-burial, thick-wall type. Low-voltage lines run elsewhere may be direct-burial, thick-wall type. Where concrete encasement is not required, low-voltage circuits may utilize factory-installed cable in coilable plastic duct.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and NEMA C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 & 8 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C, shall neither slump at a temperature of 150 degrees C, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground

shall be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.2 CABLE AND BUSWAY INSTALLATION

3.2.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.1 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters of debris is expelled from the duct.

3.2.1.2 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.3 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees Ctemperature for at least 24 hours before installation.

3.2.2 Duct Line

Low-voltage cables shall be installed in duct lines where indicated. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Direct-Burial

3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.3.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 75 mm shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 8 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 150 mm layer of backfill shall be of sand. Machine compaction shall not be used within 150 mm of the cable.

3.2.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 1.5 m in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 300 mm beyond each edge of any paving and at least 1.5 m beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.2.3.4 Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 305 m or less, nor at intervals of less than 305 m in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be

installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use.

3.3 DUCT LINES

3.3.1 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.3.2 Nonencased Direct-Burial

Top of duct lines shall be below the frost line but not less than 915 mm below finished grade and shall be installed with a minimum of 75 mm of earth around each duct, except that between adjacent electric power and communication ducts, 300 mm of earth is required. Bottoms of trenches shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150 mm. The first 150 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.3.3 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.3.3.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.4 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m outside of a building and 600 mm below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.5 GROUNDING

A ground mat consisting of the indicated configuration of bare copper conductors and driven ground rods. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded.

3.5.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade.

3.5.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.5.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.6 FIELD TESTING

3.6.1 Ground-Resistance Tests

The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

3.6.2 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor

and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.6.3 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual operation of the breaker.

3.6.4 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted including the following:

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 34 71 13.19

VEHICLE BARRIERS
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 106/A 106M	(2006) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM D 3034	(2006) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J517	(2003) Hydraulic Hose

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
SD Std-02.01,rev.a,March 2003	Certified Anti-Ram Vehicle Barriers
SD Std-02.01, April 1985	Certified Anti-Ram Vehicle Barriers

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2003) Manual of Uniform Traffic Control Devices for Streets and Highways

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

29 CFR 1910	Occupational Safety and Health Standards

UNDERWRITERS LABORATORIES (UL)

UL 486A-486B	(2003; Rev thru Aug 2006) Standard for Wire Connectors
UL 752	(2005; Rev thru Dec 2006) Bullet-Resisting Equipment

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Installation; G, AE
EquipmentG, AE

Detail drawings containing details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including foundation and clearances for maintenance and operation. Detail drawings shall include a copy of the Department of State certificate of barrier performance.

SD-03 Product Data

Vehicle Barriers

A complete list of equipment, materials, including industrial standards used and how they apply to the applicable component and manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions. Information necessary to document a minimum 1-year successful field operation performance history for each type of vehicle barrier installed.

Spare Parts

Spare parts data for each different item of material and equipment used, after approval of the detail drawings. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-06 Test Reports

Field Testing

Test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

DOD Certified Anti-Ram Vehicle Barriers - K12
DOS Certified Anti-Ram Vehicle Barriers - K12

SD-10 Operation and Maintenance Data

Vehicle Barriers; G, AE
Operating and Maintenance Instructions

Data Package 4 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Six copies of operation and maintenance manuals, a minimum of 2 weeks prior to field training. One complete set prior to performance testing and the remainder upon acceptance. Manuals shall be approved prior to acceptance. Operation manuals shall outline the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall include routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. The manuals shall also include synthetic biodegradable hydraulic oil types to be used for ambient temperature ranges of minus 34 degrees C to plus 66 degrees C to cover winter operation, summer operation, and ambient temperature ranges in between.

1.3 GENERAL REQUIREMENTS

Vehicle Barriers furnished shall in all respects be identical to the unit tested and certified except for the width of the vehicle barrier, which is as indicated.

1.4 NAMEPLATES

Nameplate data shall be permanently attached to each vehicle barrier. The data shall be legibly marked on corrosion-resistant metal plates and shall consist of at least the following:

a. Manufacturer's name.

b. Model number.

c. Serial number.

d. Date of manufacture.

1.5 BARRIER SYSTEM

The Barrier system shall be crated or mounted on skids as necessary to prevent damage from handling. The shipping container(s) shall be of sufficient structural integrity to enable the assembly to be lifted and transported by overhead crane or forklift without failure.

1.6 DELIVERY AND STORAGE

Components placed in storage shall be protected from the weather, humidity, and temperature variation, dirt and dust, or other contaminants. Structural materials shall be stored on sleepers or pallets and shall be protected from rust and objectionable materials such as dirt, grease, or oil.

1.7 SPARE PARTS

A manufacturer's standard recommended spare parts package, with current unit prices and source of supply complete with detailed manuals on parts replacement, shall be provided with each barrier to facilitate 1 year of normal operation. Particular consideration shall be given to system components which are not readily available from local or commercial sources and which are critical to the operation of the system.

1.8 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment supplied shall be available. The representative shall supervise the installation, adjustment, and testing of the equipment.

PART 2 PRODUCTS

2.1 DROP ARM GATE CRASH BEAM

The crash beam shall be an above-grade assembly that, in the "DOWN" position, shall present a visible obstacle to approaching vehicles. The height of the barrier shall be a minimum of 750 mm as measured from the roadway surface to the centerline of the crash beam. The crash beam shall be capable of blocking a minimum road width of 4 m. The crash beam end shall contain a locking pin with padlock acceptance for securing the crash beam when it is in the "DOWN" position. Crash beam shall withstand a 6804 kg vehicle traveling at 80 km/hour, with maximum vehicle penetration of 6 m.

2.1.1 Drop Arm Gate - Manual Crash Beam

The crash beam shall be manually raised and lowered with the aid of a counterbalanced end requiring approximately 134 N of force.

2.1.1.1 System Configuration

a. Barrier Construction. Barrier shall be an above grade assembly containing a crash beam hinged at one end, which can be raised and lowered manually. When in the down locked position the beam shall present a formidable obstacle to approaching vehicles. Upon vehicle impact, the force shall first be absorbed by the beam assembly and then transmitted to the foundation bollards of the unit.

b. Foundation Finish. The foundation base of the barrier shall be asphalt emulsion coated for corrosion protection. Exposed barrier surfaces shall have galvanized finish. The drop arm beam shall be furnished with red reflective tape sufficient to provide alternate 20 inch (0,5 M) bands on the Barrier tube and Barrier Yoke.

c. Foundation shall be as per Section 03 30 00.00 40 "CAST IN PLACE CONCRETE" and as shown on drawings including anchor bolts.

2.1.1.2 Performance

a. Experience. Barrier and auxiliary equipment shall be of a proven design. Manufacturer shall have 15 years documented experience with similar vehicle Barriers.

b. Qualification Tests. The barrier system shall have been tested in full scale configuration in accordance with the Department of State Certification Standard Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates, SD-STD-02.01, Revision A, March 2003, K12 rating.

2.1.1.3 Operation

The Drop Arm Barricade shall be counterbalanced by a manual counter balance system that shall permit raising and lowering the Drop Arm by a single person of normal size and strength.

2.2 PASSIVE SURFACE BARRIER

The passive surface barrier shall be a surface mounted assembly that shall present a visible obstacle to approaching vehicles. The height of the barrier shall be a minimum of 750 mm as measured from the surface to the top of the passive surface barrier. The passive surface barrier shall be capable of blocking any specified width. The passive surface barrier shall withstand a 6804 kg vehicle traveling at 80 km/hour, with maximum vehicle penetration of 6 m.

2.2.1 Experience

Barrier and auxiliary construction shall be of a proven design. Manufacturer shall have 5 years documented experience with similar vehicle barriers.

2.2.2 System Configuration

Barrier Construction. Barrier shall be an surface assembly consisting of a prefabricated, joinable, extensible, fillable, multicellular system, comprising high strength construction such as galvanized steel mesh with non-woven polypropylene geotextile lining and appropriate fill material e.g. concrete, sand, etc. The system shall present a formidable obstacle to approaching vehicles. Upon vehicle impact, the force shall be absorbed by the passive surface barrier.

2.2.3 Qualification Tests

The barrier system shall have been tested in full scale configuration in accordance with the Department of State Certification Standard Test Method

for Vehicle Crash Testing of Perimeter Barriers and Gates, SD-STD-02.01, Revision A, March 2003, rating K12.

2.3 FINISH

Surfaces shall be painted in accordance with requirements of Section 09 90 00 PAINTS AND COATINGS. The crash beam shall be painted white with 75 mm wide reflective red diagonal stripes.

2.4 CONCRETE

The concrete reinforcements, and accessories shall conform to Section 03 30 00.00 40 CAST-IN-PLACE CONCRETE.

2.5 WELDING

Welding shall be in accordance with AWS D1.1/D1.1M.

2.6 PAVEMENT

After placement of the vehicle barrier, the pavement sections shall be replaced to match the section and depth of the surrounding pavement. Pavement shall be warped to match the elevations of existing pavement. Positive surface drainage, away from the vehicle barrier, shall be provided by pavement slope.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with manufacturers instructions and in the presence of a representative of the manufacturer. Manufacturer's representative shall be experienced in the installation, adjustment, and operation of the equipment provided. The representative shall also be present during adjustment and testing of the equipment.

3.2 FIELD TESTING

Upon completion of construction, a field test shall be performed for each vehicle barrier. The test shall include raising and lowering drop-arm gate barrier or moving the sliding gate barrier manually, through its complete range of operation. Each vehicle barrier shall then be continuously cycled for not less than 30 minutes to test for heat build-up in the hydraulic system. The Contracting Officer shall be notified at least 7 days prior to the beginning of the field test. The Contractor shall furnish all equipment and make all necessary corrections and adjustments prior to tests witnessed by the Contracting Officer. Any conditions that interfere with the proper operation of the barrier disclosed by the test shall be corrected at no additional cost to the Government. Adjustments and repairs shall be done by the Contractor under the direction of the Contracting Officer. After adjustments are made to assure correct functioning of components, applicable tests shall be completed.

3.3 FIELD TRAINING

A field training course shall be provided for designated operating staff members. Training shall be provided for a total period of not less than 1

hour of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance instructions.

-- End of Section --

SECTION 43 21 39

PUMPS: WATER, SUBMERSIBLE VERTICAL TURBINE AND HAND OPERATED
04/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 2001	(2004b) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
AGMA 2003	(1997b) Rating the Pitting Resistance and Bending Strength of Generated Straight Bevel, ZEROL Bevel, and Spiral Bevel Gear Teeth
AGMA 6010	(1997f) Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA E101	(1988) Vertical Turbine Pumps - Line Shaft and Submersible Types

ASME INTERNATIONAL (ASME)

ASME B1.1	(2003) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.1	(2005) Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2004e1) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 975	(2007) Standard Specification for Diesel Fuel Oils

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2006) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(2006) Installation of Stationary Pumps for Fire Protection
NFPA 30	(2003; Errata 2004; Errata 2006) Flammable and Combustible Liquids Code
NFPA 37	(2006) Installation and Use of Stationary Combustion Engines and Gas Turbines

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Pumps of the same type shall be the product of one manufacturer.

1.2.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model, serial number, and catalog number on a plate secured to the item of equipment. Submersible pumps and motors shall also have identical nameplates affixed in a conspicuous place to the pumphouse wall or discharge piping. In addition, the nameplate for each pump shall show the capacity in L/second at rated head in meters and speed in revolutions per minute.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the fields and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies

the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G

Detail drawings consisting of a complete list of equipment and materials. Detail drawings and calculations by a Professional Engineer containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Submersible Pumping Units, Hand Pump Units, Controls and Instrumentation, Valves, and Piping; GA

The contractor shall provide manufacturer's standard catalog, installation manuals, operation and maintenace manuals, descriptive data and technical literature, performance charts and curves, and catalog cuts.

Spare Parts

Spare parts data for each different item of material and equipment specified.

Posted Instructions

Proposed diagrams, instructions, and other sheets, prior to posting.

SD-06 Test Reports; GA

Testing; GA

The contractor shall provide the following: Six copies of each test containing the information described below (items 1-7) in bound letter-sized booklets, individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible. 1) The date the tests were performed. 2) A list of equipment used, with calibration certifications. 3) A copy of measurements taken. 4) The parameters to be verified. 5) The condition specified for the parameter. 6) the inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications. 7) A description of adjustments performed.

Testing, Adjusting, and Balancing; GA

For all pumps, pump system controls and instrumentation, valves, and piping, the contractor shall provide the following:1)Two copies of the TAB schematic drawings and report forms, no later than 7 days prior to the start of TAB field measurements 2) A list of related submittals no later than 7 days prior to the start of TAB field measurements 3) Proposed procedures for TAB, submitted with the TAB schematic drawings and report forms 4) Proposed date and time to begin system readiness check 5) Proposed date and time to begin field measurement, making adjustments, etc. for the TAB report, submiited with the system readiness check report 6) Proposed date and time to begin the TAB verification, submitted with the TAB report 7) A copy of completed checklists for each contract in the project scope, each signed by the contractor's representative 8) Two copies of completed TAB reports no later than 7 days after the execution of TAB signed by the contractor's representative.

SD-10 Operation and Maintenance Data

Submersible and Hand Pumping Units, Pump Controls, Valves

Six complete copies of operating manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include simplified wiring, layout, and control diagrams of the system as installed.

Submit Data Package 3 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 year(s) of service.

PART 2 PRODUCTS

2.1 PUMP AND DRIVER REQUIREMENTS

2.1.1 Type of Installation

The work shall include furnishing, installing, and testing submersible and hand pumping units and their appurtenances as indicated. Pumps shall be

utilized for a hydrdo-pneumatic potable water supply and both pumps shall be installed in a common well, unless otherwise approved

2.1.2 Pump Drivers

Pumps shall have motor controllers with non reversible magnetic starter and overload protection with level switches for the well pump.

2.1.3 Well Data

Pumps shall be suitable for installation in the well casings and under the conditions indicated.

2.2 PUMP PERFORMANCE

Pumps shall be capable of discharging quantities of water at maximum pump speed and total pump head with the minimum efficiency indicated. Total pump head in meters shall consist of the pumping level below datum and the static and friction head above datum at design capacity.

2.3 HAND PUMPS

Hand pumps shall be provided as a backup pumping system. The hand pump shall be capable of discharging directly into the system piping at a sufficient press to fill the elevated water tank. The hand pump shall be capable of providing 25 gallons per capita per day. The pump shall be protected from freezing conditions by a drain and shall include a spigot or similar outlet for optional direct discharge of water. The pump cylinder, riser pipe, and connection rod shall be installed within a well casing pipe which may also contain the submersible electric pump. The casing and cap shall be sized to provide room for both pumps and piping, unless seperate well casings are provided. A check valve shall be provided as indicated on the plans.

2.4 SUBMERSIBLE VERTICAL TURBINE PUMPS

Unless otherwise specified, submersible vertical turbine pumps shall be constructed in accordance with AWWA E101, driven by an electric motor. Pumps shall be designed for connection to piping as indicated. A strainer shall be provided at the pump suction. Pumps shall be operable at heads above or below the normal design head as required to maintain water levels in the elevated water tank.

2.4.1 Pump Head Assembly

Pump head assembly shall consist of the surface plate from which the vertical discharge pipe is suspended and an elbow or fitting as required for connecting to the piping system. Head assembly shall be provided with eyebolts, lugs, or other means for securing slings to facilitate setting and lifting.

2.4.2 Pump Bowl Assembly

Pump bowl assembly shall include the pump bowls, impellers, shaft, and bearings and may be of single stage or multistage configuration.

2.4.2.1 Pump Bowls

Pump bowls shall have integrally-cast vanes with smooth, streamlined water passageways, and shall be constructed of close-grained cast-iron.

2.4.2.2 Impellers

Impellers shall be carefully finished with smooth water passageways and shall not load the prime mover beyond the nameplate rating over the entire performance range of the pump.

2.4.2.3 Pump Shafts

Pump shafts shall be stainless steel and the pump-motor coupling shall be stainless steel capable of transmitting the required thrust in either direction.

2.4.2.4 Bearings

Intermediate bowl bearings shall be water-lubricated bronze or fluted rubber. Top bowl bearings and suction interconnecting bearings shall be grease packed bronze or water-lubricated bronze or fluted rubber. Grease in grease-packed bearings shall be nonwater-soluble hydraulic type permanently sealed against loss. Grease-packed bearings shall be provided with sand caps to prevent intrusion of abrasive particles. Thrust bearings shall be located in the pump motor.

2.4.2.5 Strainer

A bronze or stainless steel strainer shall be furnished at the pump suction.

2.4.3 Discharge Pipe

Discharge pipe shall be sized as required to provide the required flow and pressure. Discharge column retainers or spiders shall be utilized to maintain the discharge pipe centered in the well casing. A minimum of one retainer shall be provided for each 15 m of discharge pipe except if this is in conflice with the hand pump riser pipe. Provisions shall be made for fastening the retainer spiders to prevent them from sliding on the pipe and damaging the power cable when the pump is installed in the well.

2.4.4 Check Valves

Check valves shall be provided in the column pipe located at a pipe joint as recommended by the pump manufacturer. Check valves shall be vertical type, of the same size as the column pipe in which they are installed. Check valves shall be designed to hold the column full of water, or provide bleed-back through the valve, as recommended by the pump manufacturer. Pumps with bleed-back check valves shall be provided with a positive time-delay relay that will not permit the pump to start until bleed-back is complete.

2.5 PUMP ACCESSORIES

2.5.1 Pressure Gauge

A pressure gauge of the direct-reading type, equipped with a shut-off cock and snubber, shall be provided on the discharge from each pump. Pressure gauge shall conform to ASME B40.100 and shall be calibrated in kPa and mm<ENG> feet</ENG> of water in not more than 13.8 kPa and 1.5 m increments from zero to a minimum of 34.5 kPa and 3 m above the shut-off head of the pump. Rating point shall be at approximately the mid-point of the scale.

2.5.2 Air Release/ Vacuum Valve

Provide Air Release and/or Vacuum valve with the necessary pipe connections shall be provided to permit the automatic escape of air from the discharge column when the pump is started. Valve shall b compatible with the selected pump and anticipated disharge rates and shall prevent water hammer, accumuation of air, or formation of damaging vacuum in pump column an discharge lines. Size of the valve and piping shall suit the actual requirements of the individual installation and the recommendations of the pump manufacturer.

2.6 ELECTRICAL EQUIPMENT

2.6.1 General

Electrical motor-driven equipment shall be provided complete with motors, non reversible magnetic motor starters, overload protection, high and low level or pressure switches, and controls. The control system will operate the air compressors, water pump, and air volume controller. Remote pressure switches will provide the start and stop signal for the pumps. The air compressors are operated by pressure switches mounted on the storage tank.

2.6.2 Submersible Vertical Turbine Pumps

2.6.2.1 Electric Motors

Submersible motors shall be designed and manufactured expressly for the intended use. Motor rating shall be stamped on the nameplate. Submersible motors may be the wet-stator type, dry-stator type, or oil-filled stator type. Wet-stator motors shall be filled at the factory with water treated to minimize corrosion, and shall be provided with a seal to keep interchange of cooling water and water being pumped to a minimum. Windings shall be insulated with a waterproof material. Dry-stator motors shall have rotor bearings immersed in a coolant lubricant of water-oil or water-glycol mixture, or a water-grease emulsion. When the coolant is water, it may be sealed in the motor or allowed to flow through the motor, depending upon design. Stator case shall be hermetically sealed and may be filled with a solid plastic material to help dissipate heat. Oil-filled stator motors shall be completely filled with high-dielectric constant oil. A mechanical seal shall be provided between the shaft and the motor housing and shall be designed to minimize the loss of oil. An oil reservoir shall be provided to replenish the oil loss for the life of the motor. Wet-stator motors and oil-filled stator motors shall employ a system to automatically balance the liquid pressure in the motor at any depth of submergence up to the maximum allowable. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearings shall be provided in the motor to carry the weight of all rotating parts plus the hydraulic thrust, and shall be capable of withstanding the upthrust imposed during pump starting.

2.6.2.2 Control Equipment

Automatically controlled pumps shall have three-position MANUAL-OFF-AUTOMATIC selector switch in cover. A pump low-water cutoff shall be installed in the well and shall shut the pump off when the water level in the well reaches the level shown. The sequence of operation shall be as follows: High High, High and Low Level Switches and level transmitters shall be installed in the Water Storage Tank at predetermined levels. The Level Switches shall be similar to Varec LH23-1201 Switch-Tek Mini Level Flow Switch or equal. The High High Level Switch shall set off an alarm to of the Well Pump instrumentation and the water tank is in danger of overflowing. The Low Level Switch Well Pump and Provide Dower to a Normally Open Electrically Operated Valve located on the Water Tank nozzle. The High level switch will shut off power to the Normally Open EOV so the valve will close. The Well Pump Controller will be located near the Well Pump and shall consist of a Non Reversible Magnetic Starter with Fused Disconnect Switch sized for the pump motor and a Hand Off Automatic Switch (HOA). The HOA switch will be placed in the Hand or Off position only when maintenance is being performed on the Well Pump or the Water Tank or the High High Level Alarm has been activated on the Water Storage Tank and the tank is in danger of overflowing. Otherwise the HOA switch is normally in the automatic position. A shutdown switch will also be located near the Water Tank. This switch will also be utilized only if the Tank is Overflowing. A pressure switch will be located in the Well Pump discharge line to stop the Well Pump at a designated design setting. This pressure switch shall be overridden when the HOA switch is in the Hand or Off mode.

2.6.2.3 Power Cables

Submersible power cables shall be specifically designed for use with submersible pumps, and shall be as recommended by the manufacturer of the motors with which the cables are used. Each cable shall be not less than No. 12 AWG stranded copper and shall have an ampacity of not less than 125 percent of the motor full load current. Each conductor shall be insulated with a heat resistant, moisture resistant synthetic rubber or thermosetting plastic jacket. A separate stranded, green insulated, grounding conductor shall be provided for each circuit. Single- and multiple-conductor cables shall be jacketed with a watertight synthetic rubber, plastic, or metal jacket impervious to oil or water. Metal jackets shall have a polychloroprene covering. Submersible cables shall be suitable for continuous immersion in water at the maximum depth encountered. Multiple-conductor cables may be used for ampacities up to and including 200 amperes; for greater ampacities single-conductor cables or two multiple-conductor cables shall be used. Cables shall be securely supported from the pump column at intervals not to exceed 4.5 m by corrosion-resistant bands or clamps designed to prevent damage to the cable jacket. Single-conductor cables shall be laced, cabled together, or clamped at intervals to prevent spreading apart. Except where cables are connected to the motor terminal wiring, cables shall contain no splices in the length from the junction box or motor starter to the motor. Cables shall be terminated at the junction box or motor starter with a watertight cable connector. Splices in cables will be allowed only at the connection to the motor, and may be made at that point only if there is sufficient room in the well casing without interfering with proper pump setting and operation. A waterproof plug and connector or other type of fitting may be provided for connection of the cable at the motor. Such connection shall be suitable for continuous immersion at the maximum water depth encountered. Splices shall use pressure connectors and

shall be cast in an epoxy resin, providing a homogeneous waterproof bond to the outer jacket of the cables. Splices shall be factory fabricated and tested and shall be waterproof and suitable for continuous immersion at the maximum depth encountered. For each 15 m of setting depth, 300 mm of extra cable length shall be provided to compensate for possible twist or sag of the cable during installation. Where cables pass the pump bowl assembly, cables shall be flat or protected against damage by a corrosion-resistant shield forming a smooth rounded surface. Sharp bends in the cables at the shield or at the connection to the motor will not be allowed.

2.7 EQUIPMENT APPURTENANCES

2.7.1 Attachments

All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

2.7.2 Equipment Guards

Equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guards shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.7.3 Special Tools

A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

2.7.4 Shop Painting

All motors, pump casings, and similar parts of equipment customarily finished in the shop shall be given coats of paint filler and enamel, or other acceptable treatment customary with the manufacturer and suitable for the intended service. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Each pump shall be installed in accordance with the written instruction of the manufacturer. Engine fuel supply system shall be installed as indicated and in conformance with NFPA 30 and NFPA 37.

3.1.2 Foundations

Anchor bolts and expansion bolts shall be set accurately. Where indicated, specified, or required, anchor bolts shall be provided with square plates at least 101.6 by 101.6 by 9.5 mm or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. Any templates necessary and all dimensions for setting the anchor bolts shall be furnished at the proper time. Top of the foundation shall be carefully leveled to permit the pump to hang free.

3.2 PAINTING AND FINISHING

Unless otherwise specified all exposed ferrous metal not factory finished shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS. No factory finished equipment or appurtenances shall be painted except that damaged factory finishes shall be retouched in an acceptable manner with paint obtained from the manufacturer. Nameplates shall not be covered with paint but shall be cleaned and legible at completion of the work.

3.3 TESTING

3.3.1 Factory Submersible Pump Test

Factory pump performance test shall be made in conformance with AWWA E101 for the following:

a. Running test.

b. Witnessed running test.

c. Sample calculation from test readings.

d. Shop inspection.

e. Hydrostatic test of bowl assembly.

f. Hydrostatic test of discharge head.

3.3.2 Field Equipment Test

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. The Contractor shall provide an accurate and acceptable method of measuring the discharge

flow. For submersible pumping units, an insulation resistance test of the cable and the motor shall be conducted prior to installation of the pump, during installation of the pump, and after installation is complete. The resistance readings shall be not less than 10 megohms.

3.3.2.1 Correct Installation of Appurtenances

Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

3.3.2.2 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.4 MANUFACTURER'S FIELD SERVICES

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of the equipment.

-- End of Section --

SECTION 43 32 76

CHLORINE-FEEDING MACHINES (AUTOMATIC, SEMIAUTOMATIC AND MANUAL)
04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250
ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(1998) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME BPVC SEC VIII D1	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 106/A 106M	(2006) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 587	(1996; R 2005) Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)

ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM F 441/F 441M	(2002) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

CHLORINE INSTITUTE (CI)

CI Pamphlet 1	(1997) Chlorine Manual
CI Pamphlet 6	(2005) Piping Systems for Dry Chlorine

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

30 CFR 72	Health Standards for Coal Mines

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Installation; G

Detail drawings and calculations by a Professional Engineer containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Material and Equipment

A complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

Diagrams, instructions, and other sheets, proposed for posting.

SD-06 Test Reports

Testing

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Six complete copies of operating manuals outlining the step-by-step procedures required for system startup, operation and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance manuals listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include gas pipe layout, liquid chlorine pipe layout, dilution liquid pipe layout, equipment layout, and simplified wiring and control diagrams of the system as installed.

Submit Data Package 3 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.3.2 Nameplates

Major equipment items shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 CHLORINE-FEEDING MACHINE

The machine shall be designed for the treatment of water by the application of calcium hypochlorite tablets to create a solution against a positive head using the facility's water supply system for operation of the machine. The chlorine-feeding system shall consist of controls and devices necessary for a complete operating system.

2.1.1 Capacity

Each chlorine-feeding machine shall be compatable with the anticipated raw water flow rate<ENG> pounds</ENG> and shall be capable of continuous operation at rated capacity.

2.2 PIPING

2.2.1 Water Piping

Water piping shall be as recommended by the system manufacturer based on the anticipated pressure.

2.2.2 Chlorine Piping

Chlorine solution piping smaller as recommended by the system manufacturer based on the anticipated pressure.

2.3 ELECTRICAL WORK

Electric motor-driven equipment, and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Ratings shall be as indicated. Motor starters shall be provided complete with thermal-overload protection and other appurtenances necessary for motor controls specified. Manual or automatic control and protective or signal devices required for controls and devices shall be provided. All electrical connections at junction terminal boxes and at contactor-starter unit enclosures shall be prewired.

2.4 EQUIPMENT APPURTENANCES

Bolts, nuts, anchors, washers, and all other types of supports necessary for the installation of the equipment shall be galvanized steel, cadmium plated steel, or Type 316 stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Chlorine-Feeding Equipment

The chlorine feeding machines, and all equipment appurtenances shall be installed so as to provide a complete and integrated system in accordance with the instructions of the manufacturer.

3.1.2 Pipe, Tubing, Hangers, and Supports

The installation of pipes and tubes shall be in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 TESTING

After installation of the chlorine-feeding machine is complete, operating tests shall be carried out to assure that the chlorine-feeding installation operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3 PAINTING

3.3.1 Factory Painting

Factory painting shall conform to manufacturer's standard factory finish.

3.3.2 Field Painting

Equipment which did not receive a factory finish shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS. Factory painted items requiring touching up in the field, shall be thoroughly cleaned of all foreign material and shall be primed and topcoated with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Coating shall be not less than 0.05 mm thick.

3.4 FRAMED INSTRUCTIONS

Operating instructions including wiring and control diagrams showing the complete layout of the entire system shall be provided. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form.

3.5 MANUFACTURER'S FIELD SERVICE

3.5.1 Manufacturer's Supervision

Services of a representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

End of Section --